ELECTRICAL REVIEW

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ELECTRICAL REVIEW

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13 MAY 1955

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ELECTRICAL REVIEW

13 May 1955 Vol. 156 No. 19 Established 1872

Electrical Research

ELECTRICAL research work is not everyday news and it is only on comparatively few occasions such as, for instance, the publication of its annual report on the occasion of the annual general meeting and its annual luncheon, both of which took place in London last week and both of which are reviewed and reported elsewhere in this issue, that the British Electrical and Allied Industries Research Association finds itself in the limelight in the sense that its normal commercial and technical business and trade developments receive publicity.

The annual report reviewed in this issue as usual makes extremely interesting reading and it is regrettable to us that we have to confine our comments on it within the limits of a short survey dictated by essentially practical considerations.

Like Lord Woolton, who as guest of honour at the luncheon, expressed similar sentiments, we marvel at the extensiveness and diversity of the subjects embraced in the work of the Association ranging from, say, electrical surge phenomena to electric heating and cooking problems, the work in some of the wider subjects being sectionalized under more abstruse headings: for instance astrophysics is a sub-study in one section.

Then there is the organization side shown by the chart which is included in the Report. It shows great enterprise and an organizing ability not usually associated in the public mind with research, embracing as it does some hundred or so standing main committees and sub-committees, all with a certain latitude and freedom of working while they are ably guided from the centre. These standing committees also suggest a most extensive range of studies, from high-voltage transmission to communication interference.

The link with the universities is another vital aspect of the Association's work; it is of the greatest importance to ensure that specialized research works in parallel with fundamental research.

The funds for the continuance of all this valuable work depend largely on the volume of the voluntary subscriptions and contributions, for this forms the basis of the assistance received from the Government. While costs continue to rise the maintenance of research work depends on an increasing income; otherwise there may be a serious curtailment of programmes. We are confident that the leaders of the electrical industry will not let this happen, particularly if they fully acquaint themselves with the excellent work of the staff of 300 under the directorship of Dr. S. Whitehead.

ATOMIC ACTIVITIES

Signs of increasing activity in connection with the development of power from nuclear energy are multiplying. We have already reported the formation of four industrial groups, each consisting of an electrical manufacturing concern and a boilermaking company (*Electrical Review*, 25th March). Now Sir Claude Gibb, chairman and managing director of C. A. Parsons & Co., has given more details of his company's collaboration with Head, Wrightson & Co. and other concerns. Plans are in hand for a new works especially devoted to the production of nuclear power plant near the Parsons works at Heaton. Another aspect of the same subject is the advertising by the Central Electricity Authority for senior engineers to plan " atomic " power stations and lead research into the development and use of nuclear power. There is also a call for applications for subordinate positions in the same departments. All of this is of importance to the future of power production in this country and also of significance in its influence on future export trade.

OFFICIAL HELP

Speaking at the annual meeting of the London Chamber of Commerce last week Lord Luke (the president) said he did not believe that the work of the British consular service in foreign countries was sufficiently appreciated by salesmen and other representatives of British firms travelling abroad. The members of that service were anxious that visitors should give ample previous notice of their intentions so that contacts could be made for them. We can testify from our own experience how helpful British Government trade officials abroad can be; they have a keen sense of duty towards British firms who aim at increasing their export trade. Lord Luke also referred to the British Chambers of Commerce overseas and called for greater support both by large and small concerns. These bodies, he said, were potentially very valuable in dealing with trade matters with the authorities of their respective countries.

MANY-SIDED ACTIVITIES

The annual reports of the British Electrical Development Association reflect the many facets of electricity's part in modern times. There is hardly any aspect of industry, commerce and everyday life in which electricity does not enter in some way and it is true to say that the more E.D.A. does to encourage the use of electricity the more it finds to do. Development in the electrical sense originally meant stimulating consumption but now it connotes much more than this. To an increasing extent the Association has become an advisory body and its function is not merely to boost sales but largely to ensure that electricity is used effectively and economically. In point of fact this, too, actually raises the demand—and so it goes on.

MAGNETIC MOULDED PRODUCTS

In his article on " Moulded Magnetic Materials " in this issue Mr. G. R. Polgreen shows the great advance that has been made in the development of moulded magnetic materials, which include both ferrites and magnetic powder cores. These are manufactured by processes closely associated with powder metallurgy and form a marked contrast to the conventional magnetic materials produced by the steel industry. Ferrites are made from sintered mixed oxides, while alloy powder cores are produced by hydrogen reduction of heated mixed compounds of ferromagnetic metals. Despite their physical difference they have many common qualities: each can be made either with low losses or with permanent magnet properties. Production methods ensure uniformity of size and performance for large quantities of components of similar design, which is of particular importance in electrical engineering and for industry in general. Each type of material has advantages and limitations; thus a range of products is required to cover the wide and growing field of applications.

ELECTRONIC CONTROL

The article by Mr. Howard in this issue on " Continuous Strip Production " points to the increasing use of electronic control of motor driving in an ever widening production field, no doubt partly because of the influence of materials handling and with it the precision and sequence control called for in this field, and partly also because of the demands for higher and higher production. The particular application referred to by Mr. Howard is required in many fields from the steel industry to, say, the paper mill, in which unwinding from a coil at the feeding end and winding on to a coil at the delivery end must be effected at continuously increasing rotary speed in one case and in continuously decreasing rotary speed in the other, so as to ensure a constant peripheral speed in both cases as the diameter of the coil is decreased or increased. This calls for a precision of control which electronic methods provide most satisfactorily.

THE GREEK MARKET

Greece with its population of seven or eight million is not a wealthy country but it has some undeveloped resources which could be exploited to the country's benefit. A prerequisite is a supply of electric power and, as will be gathered from an article in this issue by Mr. M. A. Veronikis, a Greek electrical engineer, schemes are in hand and in prospect for providing this. It is unfortunate that British electrical manufacturers are so far not playing a great part in the electrification of Greece; for various reasons contracts have gone to a number of other countries. The English Electric Co. has, however, obtained a contract for the extension of the St. George's Bay station of the Athens-Piræus Electricity Co. which it constructed in 1927. Opportunities for the provision of capital plant will occur in the future and there should be scope for all classes of utilization equipment. Finance seems to be the deciding factor in Greece as in so many other undeveloped countries.

Coffee percolators will be the subject of the next in our series of illustrated surveys of domestic electrical apparatus (20th May issue). Particulars, given in tabulated form, will include details of type, capacity, element loading, body finish and price

Moulded Magnetic Materials

A Growing Field of Applications

By G. R. POLGREEN, M.B.E.

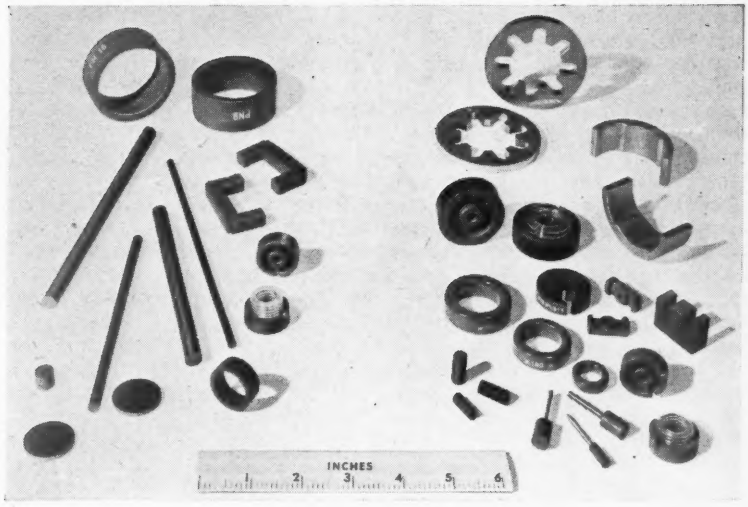


Fig. 1—Moulded magnetic materials : ferrites (left) ; powder cores and micropowder magnets (right)

A QUARTER of a century ago magnetic materials made from chemical substances were first introduced on a commercial scale, some as permanent magnets made from sintered mixed oxides and others as alloy powder cores made from the reduction in hydrogen of mixed compounds of ferromagnetic metals. Hitherto almost all cores and magnets in the electrical industry have been made by conventional metallurgical processes primarily developed for the manufacture of steel and similar metals.

The advance in both theoretical and practical aspects of magnetic materials since the early 1930's has been so great that it probably now exceeds all earlier progress in this subject during the past 25 centuries of recorded scientific activity, for the properties of magnetic oxides were noted by the ancient Greeks and Chinese. In recent times the range of frequencies used for practical purposes in electrical engineering has increased about one millionfold and there has arisen a need for magnetic materials with new or improved properties and greater stability. These demands have been achieved to a remarkable extent by moulded magnetic materials made from chemical compounds and oxides and this article describes their properties and compares them with conventional metals and alloys.

Magnetic theory has kept pace so well with these recent developments that it has now become possible to predict the course of new developments, as in the case of permanent magnets made from ultra-fine pure iron powder, a metal hitherto accepted as the basic " soft " or low loss magnetic metal.

This article opens with a brief description of the general properties of low loss magnetic powder cores and micropowder magnets, which together will be known as the " powder group," and all kinds of ferrites, whether possessing permanent magnet properties (high hysteresis loss) or low magnetic losses. In order to explain and compare their magnetic and electrical performance it is necessary to consider the effects of subdividing a magnetic core on the basic magnetic properties, such as coercivity, saturation flux density, the shape of the hysteresis loop and the resulting permeability and electrical resistivity values.

In the past it has been usual to treat permanent magnets and low loss magnetic metals as separate materials with many differing physical properties. Present knowledge indicates that they can now be regarded as almost identical, apart from the coercivity value, which can be controlled.

The chief difference between the ferrites and metal powder groups of magnetic materials lies in their mechanical hardness. All powder cores and micropowder magnets are physically soft and can be pressed into solid mouldings with excellent surface finish; in many cases they can be machined and drilled. All ferrites on the other hand are so hard that they must be ground to size with special abrasives. They are manufactured with ceramic techniques by heat treating compressed mixed oxides at temperatures in the region of 1,250 deg C with considerable shrinkage.

A comparison between ferrites with cores and magnets of the powder group is given in Fig. 1. It will be seen that many shapes can be produced with materials of either group, especially ironclad or cup cores which represent the most efficient electromagnetic design impossible to achieve with earlier materials. The electrical resistivity of ferrites is inherently high (in the region of 100 to 100,000 ohms/cm) and they can therefore be used without subdivision in the form of massive blocks or extruded rods.

The powder group of mouldings can be made from either insulated or uninsulated ferromagnetic metal powders, but in each case a high moulding pressure is employed. Their advantage lies in the fact that they do not require high temperature heat treatments and so the physical shrinkage is almost negligible; hence they can be moulded to greater accuracy of dimen-

TABLE I.—SUMMARY OF NEW MAGNETIC MATERIALS

MOULDED MAGNETIC MATERIALS				
TYPE:	FERRITES (SINTERED MIXED METALLIC OXIDES)		METAL POWDERS (IRON & IRON-ALLOY)	
PROPERTY:	LOW-LOSS	MAGNET	LOW-LOSS	MAGNET
PRINCIPAL PRODUCT:	MANGANESE-ZINC FERRITE NICKEL-ZINC FERRITE	BARIUM FERRITE	ALLOY POWDER CORE IRON POWDER CORE	ALLOY MICROPOWDER IRON MICROPOWDER
CHIEF APPLICATIONS:	TELEVISION TELECOMMUNICATIONS RADIO AERIALS HIGH PERMEABILITY	TV. FOCUS GENERATOR	TELEPHONY TELEVISION RADIO HIGH FLUX DENSITY	INSTRUMENTS, ETC. METERS SMALL MAGNETS

sions and in more complicated shapes than ferrites, and it is also possible to incorporate other metal parts and powders and certain non-metallic substances in the mouldings.

A brief summary of these materials and their present more important applications is given in Table I. The chief constituent of all magnetic ferrites is iron oxide with varied proportions of other oxides or compounds of certain metals. There are two principal types of low-loss ferrite at present in use: the manganese-zinc grade is used for television transformers and yokes and for cores operating at the lower telecommunication frequencies up to about one megacycle; nickel-zinc ferrite is used in a variety of proportions up to the higher radio frequencies. Barium ferrite magnets are used principally for the focusing of television tubes.

Iron powder cores were first produced in America about 40 years ago for the cores of loading coils for telephone cables which are introduced into each telephone circuit at distances of 2,000 yards along the route in order to reduce attenuation. The earlier iron wire and stamping cores led to severe instability and the compressed powder cores represented a remarkable improvement. Further increase in quality with reduction in size was obtained by the introduction of nickel-iron alloy powders for this purpose.

Many hundreds of thousands of loading coils are made in this country annually and similar toroidal coils are also used for filter inductances for carrier telephony equipment. Their principal properties are their remarkable stability and constancy of performance under all conditions of vibration, shock and superposed electrical currents together with compactness and complete absence of leakage flux. Large numbers may thus be installed in very restricted space in underground manholes and telephone exchanges.

Insulated Powders

For higher frequencies very large numbers of types of radio cores are now used and, since these are mostly of low permeability, pure iron powder is used in their construction and they can be moulded with plastic insulation on the particles at comparatively low pressure. This makes it possible to use more varied designs than the ring core with its difficulty of winding and inductance adjustment. Radio cores are made principally in cylindrical form with either screwed brass stems, moulded during pressing, or else a screw thread is ground on the outside on automatic centreless grinding machines. Many millions of both these types of cores are made each month in this country for the radio and electronic industries and a considerable number of each is used in every radio and television receiver for intermediate transformers and adjustable inductances.

Micropowder magnets are made from extremely fine iron or iron-alloy powder deriving permanent magnet properties from crystal size alone. This technique is a very recent development and these magnets have numerous advantages arising from their low specific gravity, physical softness and economy of raw materials. Although some of their principal applications at present are in the field of electrical measurements, there is every indication that they will also make possible improved electromagnetic designs for many other applications.

The magnetic properties of most of the materials now used in the electrical industry are shown in Fig. 2, associated with typical hysteresis loop which indicates the principal terms and symbols used for this subject. The area of the loop gives a measure of the electrical power loss due to the magnetic hysteresis when a ferromagnetic material is placed in a coil carrying alternating current. The most important properties of magnetic materials are the coercivity and saturation flux density, and the values of commercially available metals and ferrites are indicated approximately against the scales which have been drawn respectively on the left and right of the diagram.

If magnetic materials are made from powder, which is the form in which the raw materials are used for moulded cores and magnets, it is necessary to consider the effect of this subdivision of the magnetic circuit, which is indicated in Figs. 3, 4 and 5. The first of these shows an insulated powder ring core with an enlarged view of a small part of the surface which indicates the particles as regularly spaced insulated cubes. While this may be thought very different from the wide range of particle sizes and diversity of particle shapes to be found in most commercial metal powders, it serves as a useful basis for calculation purposes. The diagram shows that the equivalent magnetic circuit is a ring of the solid magnetic metal of reduced diameter with an air gap. The latter consists of insulating material and air, or sometimes of air alone, as in the case of powder cores and magnets made from uninsulated powders which are physically soft and are moulded at pressure intensities above the elastic limit of the metal.

The effect of the subdivision on the hysteresis loops is indicated in the lower part of Fig. 3 which shows the considerable effect of the equivalent air gap on the shape of hysteresis loop giving a great reduction in permeability and remanence. The effect of the area reduction due to insulating and non-magnetic space is comparatively small and is mainly confined to a corresponding reduction of saturation flux density and remanence.

The reduction of the permeability due to the insulation is accompanied by a vast increase in the resistivity of the composite cores which may be nearly one million times greater than the resistivity of the solid metal for an insulation proportion of only 2 per cent by weight. Higher insulation percentages increase the resistivity of the composite material to any required value up to that of insulators and the relation between material permeability (μ_m), composite permeability (μ_c) and resistivity is given approximately in Fig. 4, all the scales being logarithmic.

The vertical scale gives permeability and shows the approximate position of the well-known low-loss and permanent magnet materials, the figures for the latter being the remanence divided by the coercivity, which gives the value under optimum working conditions and forms a useful comparison with other magnetic materials.

The first set of curves shows the great reduction in permeability due to the air-gap ratio factor (g) and using the formula in Fig. 3. The values for g vary from 0·1 to 10 per cent between lowest and highest frequencies and the shaded portion indicates the working zone for the powder group of materials. It should be noted that the use of very high permeability materials will have negligible effect on the

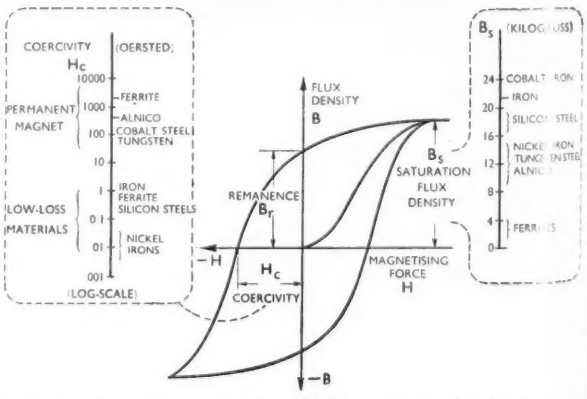


Fig. 2—Magnetic properties of moulded material associated with hysteresis loop

value of μ_o for this shaded area. These curves also show that a very small amount of impurity or irregularity of structure will greatly reduce the real permeability of a core which is primarily composed of an extremely high purity iron or nickel-iron alloy.

The right-hand curves give resistivity in ohm/cm units plotted horizontally against the same vertical permeability scale. The resistivity of a good insulator is about 10^{14} ohms/cm and that of the best-known electrical conductor is 10^{-6}. The narrow band indicates the value for all the iron and iron-alloy magnetic metals in the left-hand table and the two curves marked " iron " and " nickel-iron " show the increase of resistivity obtained by the reduction in permeability resulting from the increasing percentage of insulating material. These curves represent well-insulated powders with regular and smooth surfaces. Micropowders can be insulated by similar methods to those used for low-loss powders and the line marked " iron magnet " indicates the lower resistivity for equivalent permeability. The line marked " oxide magnet " refers to ferrites and magnetic oxides pressed with binders which have very low permeabilities on account of their inherent low remanence and high coercivity.

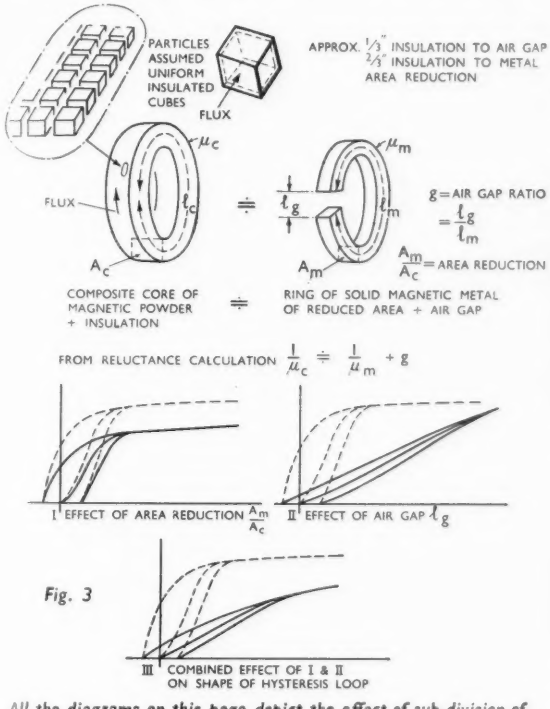

PARTICLES ASSUMED UNIFORM INSULATED CUBES
FLUX
APPROX. 1/3" INSULATION TO AIR GAP
2/3" INSULATION TO METAL
AREA REDUCTION
FLUX
g = AIR GAP RATIO = lg/lm
Am/Ac = AREA REDUCTION
COMPOSITE CORE OF MAGNETIC POWDER + INSULATION
RING OF SOLID MAGNETIC METAL OF REDUCED AREA + AIR GAP
FROM RELUCTANCE CALCULATION 1/μc ≐ 1/μm + g
I EFFECT OF AREA REDUCTION Am/Ac
II EFFECT OF AIR GAP lg
III COMBINED EFFECT OF I & II ON SHAPE OF HYSTERESIS LOOP

Fig. 3

All the diagrams on this page depict the effect of sub-division of the magnetic circuit where materials are made from powder

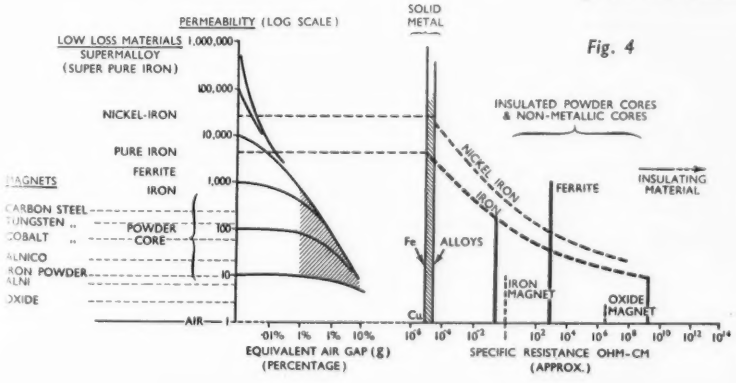


Fig. 4

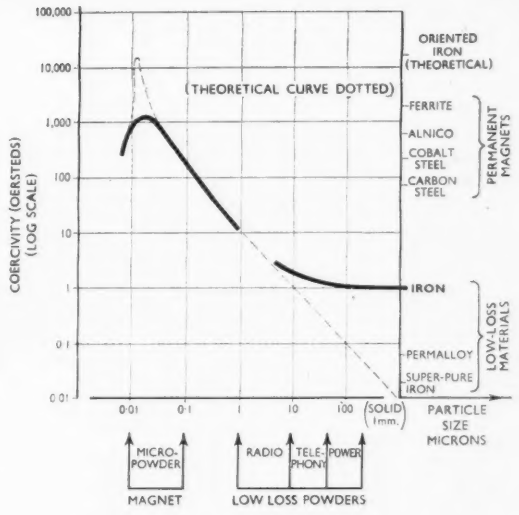


Fig. 5

The low-loss ferrites are indicated by the line in the centre of this curve which represents an average value between the manganese-zinc and nickel-zinc materials. The much higher permeability compared with powder cores of either iron or alloy powder is most marked. However, the lower permeability powder cores of the screw and slug types used in quantities for radio and television sets give the highest value in the curve and this, together with their low cost, indicates their advantage compared with ferrites of similar size.

Although the information summarized in Figs. 3 and 4 refers primarily to powder cores and micropowder magnets, it can be used to explain the reduction in the permeability of extruded ferrites compared with the same material made by moulding. It also indicates the change in properties of magnetic powders and oxides dispersed in suitable liquids, as used for coating surfaces for magnetic recording.

Magnetic powders with smaller particle size were developed originally in order to obtain lower eddy current losses for higher frequency applications. The average particle of a radio core powder is nearly one hundredth of the diameter of a coarse powder originally used for low frequency cores, and it was found that the coercivity of the finer powder was appreciably higher than that of the pure iron powders with larger particles prepared by the reduction of iron oxides or compounds in hydrogen at medium temperatures. Work carried out in France and later in America on much finer iron powders than any hitherto produced indicated that the coercivity increased rapidly as the particle size was further diminished* and an optimum value was reached at about 0·02 micron (1 micron is 0·001 mm or 10^{-6} metre). Below this critical size the coercivity falls off very rapidly as the particles approach atomic dimensions.

A curve showing coercive force plotted against particle size in microns, both to logarithmic scales, is given in Fig. 5. The approximate coercivity

* Carbonyl iron powder does not behave in this manner for reasons still not perfectly understood.

value of common magnetic materials is again marked to indicate the permanent magnet and low-loss zones. The maximum coercivity of the iron powder in practice is about 1,000 oersteds which is greater than that of any commercial magnet, apart from barium ferrite, but if all the particles were of the exact optimum size it has been estimated that the value would be increased to over 10,000 oersteds. At the other end of the scale super purity iron in solid form has been produced on a small laboratory scale with a coercivity as low as 0·02 oersted (or about one fiftieth the average value for commercial iron) with permeability approaching one million (see Fig. 4).

The investigation of the micropowders, as the very fine powders with high coercivity derived from their crystal size are now termed, was a direct result of theoretical work associated with the domain theory of magnetism, which was originally put forward to explain the B-H curve and hysteresis phenomena of ferromagnetic materials. All these materials, according to theory, are ultimately composed of small domains which are permanent magnets and they group themselves into larger structures in which the resultant magnetic flux may either be very small or assume any value up to saturation. The coercive force is dependent upon the saturation flux density and thus pure iron and cobalt-iron alloys are of great practical importance as micropowders. Another important factor in obtaining useful practical magnetic materials is the degree of orientation of the structure, or in other words the extent to which the equivalent series gap can be reduced.

Because of demagnetizing effects there is an optimum spacing between the domains to give maximum coercivity which is diminished if mechanical pressure or thermal treatment is applied. Thus, when micropowder is compressed or heat treated at a comparatively low temperature, the coercivity is reduced but the remanence increases approximately with the physical density. This is of the greatest practical importance since the micropowder alone has a very low physical density and must be compressed to make it into a practical magnet. By varying the pressure intensity it is possible to produce any desired ratio of remanence to coercivity over a wide range, which is an advantage unknown in other permanent magnets.

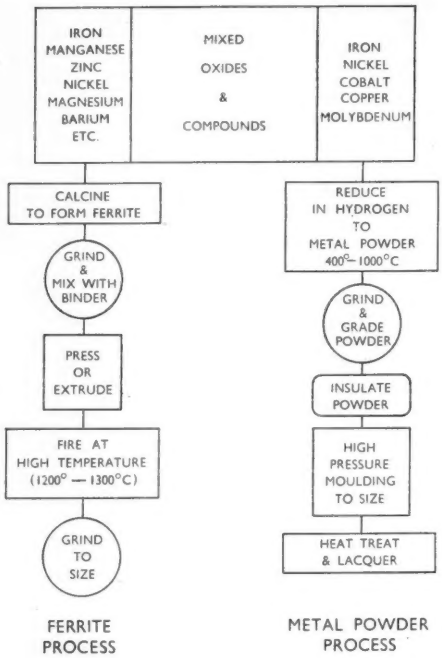


Fig. 6—Outline of basic processes for making ferrites

An outline of the basic processes for making ferrites and materials in the powder group is shown in Fig. 6. From similar kinds of raw material two very different groups of products are made and yet the manufacturing methods are close to those used in conventional powder metallurgy. Both materials are handled in powder form in the pressing stage but whereas the mixed oxides for making ferrites are sintered at high temperatures in order to make solid compacts, the metal powders and micropowders are compacted by pressure, together with a binder in some cases, because of their physical softness. This characteristic is obtained in the hydrogen reduction process which changes the oxides from a very hard abrasive substance to a soft metal powder. The range of temperatures is required to give a wide variety of powders, the finest crystal size being obtained by reduction at the lowest temperatures. In some cases, particularly in the production of coarse alloy powders, additional heat treatment and processing are necessary.

In the case of ferrites, the binder is used to ensure that the incompressible mixed oxides can be moulded to the required shape. The pressed compacts are weak mechanically and attain their mechanical strength in the sintering process which also volatilizes the binder and leaves the final ferrite in a hard and homogeneous condition, the shrinkage being about 20 per cent in linear dimensions.

Handling Difficulties Overcome

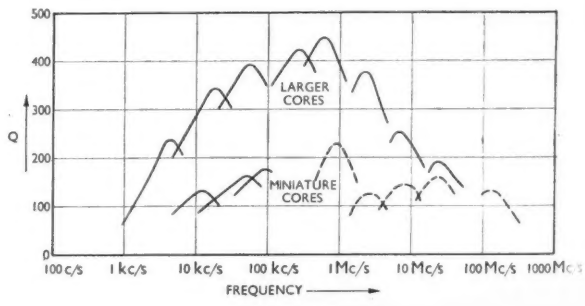
Whereas the insulation process is used in the production of magnetic powder cores to minimize eddy current losses, a similar process has been developed for micropowders to overcome the danger and handling difficulties resulting from their extreme fineness. Once they are compressed to a density which also imparts adequate mechanical strength to the compact, micropowder magnets are very stable. The methods now used on a production scale make it possible to store and handle these materials without risk and to produce either high remanence or high coercivity magnets from the same material according to final methods of processing the pressed micropowders.

The powder group of products are slightly porous in their final stage and so are vacuum-impregnated with suitable plastic materials which render them impervious to moisture. As an extra precaution a coloured stoved lacquer is finally applied which serves as a colour code and an added protection. Ferrites are non-corrodible in their finished state and do not require protective coating.

For their electrical and magnetic performance it is necessary to consider these materials separately under the low loss and permanent magnet categories:—

The most important application for both ferrites and powder cores is in the field of telecommunications. The curve in Fig. 7 indicates the wide range of frequencies, up to and over 300 Mc/s, for which they are now chiefly re-

Fig. 7—Indicating wide range of frequencies for which materials are required



quired, although there are other applications in the microwave region of 20,000 Mc/s. For much of the range in the curve it is possible to use either ferrites or powder cores and the choice is often based on economics and general considerations. Ferrites cannot be readily used in the form of toroidal cores since it is necessary that they shall be used with an air gap to give the required stability; for this reason the only design that can be efficiently used for the lower frequency bands is the ferrite pot core in which the gap is preferably situated in the centre in order to minimize leakage flux.

The ferrites have performance advantages in the centre of the frequency scale in Fig. 7, particularly in the case of larger cores for such uses as television line transformer cores. At the lower and higher frequencies, powder cores generally give better performance, and this will also apply in high flux density applications, such as interference suppressors.

The high flux density performance of a number of grades of iron powder cores, both insulated and uninsulated, is given in Fig. 8 which indicates the reduction in saturation flux density as the degree of subdivision and amount of insulation are increased, the lower curves representing higher frequency grades of core material.

The magnetizing curves of the four grades of micropowder magnet now in production are shown in Fig. 9. It was shown earlier that it is technically possible to make these magnets with any required ratio of remanence to coercive force, but for manufacturing reasons these have been limited to high remanence and high flux density grades for two qualities of micropowder made respectively from cobalt-iron alloy and pure iron. The energy product of the alloy micropowder in the high remanence grade is similar to that of the best non-oriented (isotropic) magnet in the steel group with 40 per cent lower specific gravity, and this represents an appreciable improvement in efficiency under comparable conditions.

The ferrite magnets are limited to much lower remanence figures than those of the micropowders but their high coercivity gives advantages unobtainable with other magnets for special use. However, the majority of magnets are used with comparatively short air gaps for which higher remanence is desirable, particularly if pole pieces are not used. Conventional cast magnets are extremely hard, especially in the higher energy grades, and the design of magnetic circuits incorporating them is usually governed and complicated by this factor. Owing to their physical softness micropowder magnets can be moulded into complete magnetic circuits which can be drilled or shaped and so the use of pole pieces can often be avoided with advantages of simplicity, greater efficiency and lower cost.

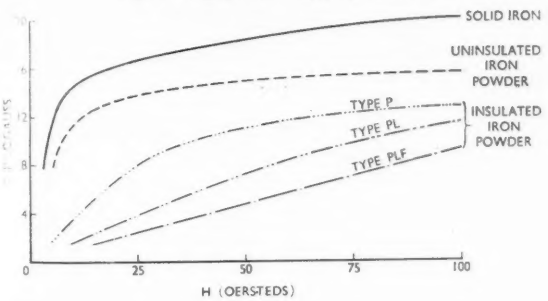
TABLE II.—COMPARISON OF PROPERTIES OF MAGNETIC MATERIALS

	Steel Group		Powder Group		Ferrite Group	
Type	**Magnet**	**Low Loss**	**Magnet**	**Low Loss**	**Magnet**	**Low Loss**
Basic Material	Solid Metal	Sheet Metal	Metal Micropowder	Metal Powder	Mixed Oxides	Mixed Oxides
Physical Properties	Hard	Soft	Soft	Soft	Hard	Hard
Density gm/cm³	7 to 8		4 to 5	5 to 7	4 to 5	
Resistivity	Low (Conductor)		Low or High		High (Insulator)	
Saturation Flux Density	High		Medium-High		Low	
Remanence	High		High-Low Can be varied		Low	
Coercivity	Low-Medium				High	
Construction	Solid alloy ground to size	Assembled laminations	Moulding to accurate size with inserts, pole pieces, shafts, etc.		Moulding, sintering and grinding to size	

High coercivity micropowder magnets are made with a binder and possess high specific resistance (Fig. 4) with specific gravity of the order of 4 gm/cc. The high remanence grades have no binder and thus the resistivity is low but the specific gravity is therefore increased to about 5 gm/cc. These magnets have permeability values of 25 and 12 respectively for high remanence and high coercivity, compared with the much lower figures for ferrite and oxide magnets which are of the order of 1 to 2. It will thus be clear that these materials are complementary in their performance and together can cover a considerable part of the very diverse demand for permanent magnets.

The micropowders and magnetic oxides can be mixed in various plastic and insulating liquids to form a dispersion which can be spread on to plastic sheet and bands for recording purposes. Present production materials of this type are based on magnetic oxides, which have low magnetic energy and are very abrasive, so there would appear to be

Fig. 8—High flux density performances



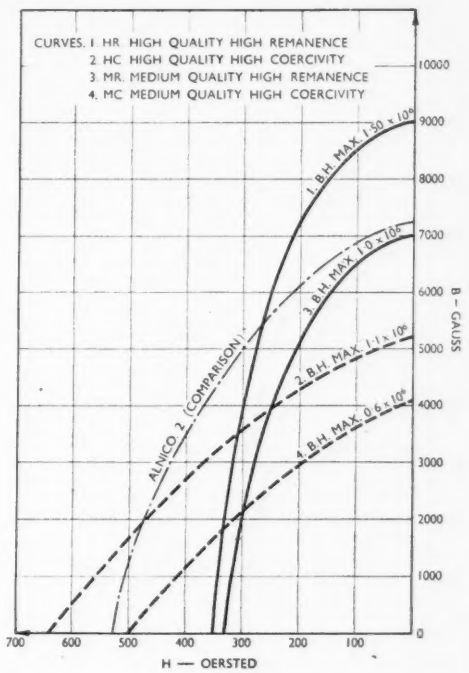
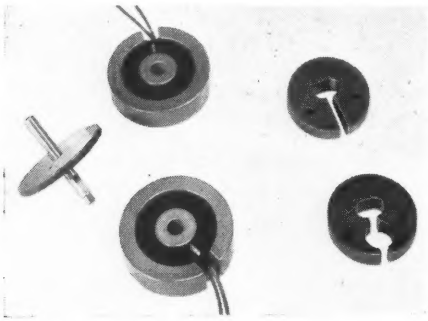


Fig. 9—Magnetizing curves of the four grades of micropowder now in production

Fig. 10—Powder cores and micropowder magnets for measurement applications : (left) instrument transducer cores ; (right) magnets for meters and instruments



considerable possibilities for the use of the softer micropowders which can be rendered non-corrodible for these applications, and can carry much more energy per unit area of the recording medium.

The comparison of the properties of the three groups of magnetic material, steel, powder and ferrite, can conveniently be summarized in tabular form (Table II). Although the steel group has the general advantage of mechanical strength, the moulded materials are strong enough for most practical applications except when subjected to severe shock. The principal disadvantage of the steel group is the fact that all metals are good conductors of electricity and therefore have considerably eddy current losses especially at frequencies in the telecommunications range. Also permanent magnet metals with high energy factor are extremely hard physically which limits their efficiency and usefulness. Most of the better quality materials in the steel group are made from expensive alloys of nickel and cobalt and other strategic metals which are often in limited supply, so both micropowders and ferrites have important advantages in this respect.

Permanent magnets in the steel group have the highest energy factors on account of the orientation process introduced during their manufacture. The principal advantage of the powder group of materials is that they are all physically soft and this is of particular importance in the case of every grade of micropowder magnets. They generally combine high saturation flux density and low eddy current loss and the permeability can be varied over a wide range, in the case of both cores and magnets, in a manner which is not possible with the other materials. However, there is an upper limit to the permeability of the low-loss cores which can be exceeded only by sacrificing the high resistivity value.

It is the achievement of high permeability, high resistivity and low losses in the same material that gives ferrites their particular merit and makes possible their wide application for television transformers, aerial rods and permeability tuners. Ferrite magnets have the special property of highest coercivity which is of use in magnetic circuits with large air gaps, together with highest resistivity which is useful for alternating current applications.

All ferrites are made from comparatively cheap and abundant raw materials and, although their production costs are somewhat high, they have important economic advantages for simple shapes produced in large quantities for low flux density applications. They are unsuitable, however, for magnet applications with comparatively small air gaps in which high remanence and close dimensional tolerances are needed. It is for these purposes that the micropowder magnets have a considerable future, especially if the advantages of their softness and the possibilities of moulding them with other materials and components are fully used. The micropowder and ferrite magnets have smaller energy factors than the best materials in the steel group but their lower specific gravity and the possibility of making improved electro-magnetic designs with less leakage flux tend to minimize the difference in practice.

Moulded materials together present the following considerable advantages compared with the steel group : —

(*a*) Improved electro-magnetic designs such as ironclad cores.
(*b*) Greatly increased resistivity generally making it unnecessary to laminate the magnetic circuit.
(*c*) Economy of raw materials during manufacture and in the composition of the finished products.
(*d*) Lower specific gravity.
(*e*) Use of powder metallurgy methods which result in greater uniformity and lower costs for large quantity production.

The last of these advantages introduces what is perhaps the most important requirement of powder metallurgy, that there shall be large quantities made to the same or very similar designs. An important example of this is shown in Fig. 10 which illustrates the low-loss cores used in a transducer for measuring mechanical quantities by electrical methods, together with two similar shaped micropowder magnets used respectively for small indicating instruments and electricity meters. The transducer cores are adapted from designs used for telecommunication circuits. The two permanent magnets can be made in the same press tools provided with replacement inserts for the parallel air gap for meters and for the circular air gap for instruments. Moreover the depth of these magnets can be increased in order to give additional air gap flux, or to use pure iron micropowder in place of the more efficient alloy micropowder in order to economize in the use of the strategic material cobalt. This makes allowance for the difference in remanence between the two materials, the value of the alloy micropowder being nearly 30 per cent greater (Fig. 5) for approximately the same coercivity.

A description of the methods used in America for making various kinds of moulded magnetic material is given in an O.E.E.C. Report on Powder Metallurgy due to be published soon. The author was a member of the European Mission which visited the United States in October and November, 1953, and contributed to the section on " Electrical and Magnetic Materials " in that report.

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N.P.L. OPEN DAY

THE National Physical Laboratory, Teddington, is holding an Open Day on Friday, 20th May. Admission is by ticket only and a limited number of invitations for the afternoon period, 1.30-5.30 p.m., are still available on application to the Director.

Conservation of Natural Resources

First Graham Clark Lecture

AT a joint meeting of the Institutions of Civil, Mechanical and Electrical Engineers held at the Institution of Civil Engineers on 4th May Sir Harold Hartley, K.C.V.O., F.R.S., delivered the first Graham Clark Lecture on "The Engineer's Contribution to the Conservation of Natural Resources."

It was, Sir Harold said, the ingenuity and initiative of the engineer in satisfying the growing demands of the world which had stepped up the consumption of natural resources so that the ever-growing inroads upon them had now become a matter of serious concern. How was the idea of conservation to be reconciled with the steadily increasing consumption by the engineer of the world's natural resources? Soil and water were the natural resources on which civilization had been built and these to-day were proving the limiting factors both in development and in supplying the world's food. It was here from the earliest times that the engineer had made his basic contribution to the conservation of resources.

Water Storage

He put water first, as it was essential to all forms of life and industry, and was proving more and more to be the indispensable resource on which plans so often had to be based. Without it soil became a desert, production an impossibility; but water was also a potent source of destruction and a carrier of disease, so that the engineer had here a dual task. The advent of hydro-electric power and the advance in engineering techniques had made possible the multi-purpose schemes for water control with their objectives of flood control, power supply, irrigation and transport. But there was another side to the picture. Silt was the great problem of the future for the hydraulic engineer, as with the loss of storage capacity the output of the power station would become more and more dependent on the seasonal flow and more serious still would be the loss of perennial irrigation where it was dependent on storage. The ultimate solution might be new high dams, but the best sites had already been chosen.

Flying had revolutionized the methods of large-scale surveying, as by means of aerial photography with stereoscopic cameras to trace the contour lines the preliminary work of mapping new schemes could be done with great speed and accuracy of detail. Modern geophysical methods enabled the underlying strata to be determined with great savings of time and effort. The measurement of the time taken by seismic waves, set up by an explosion, to travel directly or after refraction through the underlying rock enabled the depth of the bedrock at various points to be determined with an accuracy of 10 per cent. The electrical resistance of soil and sub-soil depended largely on its moisture content and it varied from rock to rock, so that resistance measurements between different points was another means of determining underground conditions and the existence and depth of a water table. The technique of using scale models in which the effects of changed conditions could be speeded up a thousandfold was now sufficiently advanced to enable a fairly accurate forecast to be made if the model was well planned and its limitations clearly recognized, and model studies were now almost invariably a condition of the contract for major hydraulic works.

On irrigation, Sir Harold said that the present land area of the world cultivated for food was about 1,620 million acres, and of this 230 million acres was under irrigation. It might be possible to double this irrigated area in places where water was the limiting factor in cultivation, as in India, where only 6 per cent of the river flow was used in this way: but the engineer's task was not finished when he had provided the irrigation water, since it brought with it the danger of salinity, and alkaline soils now threatening large areas of the Punjab. Much more needed to be known about the movement of water in the soil, much more about the underground water resources and much more about the possibilities of these multi-purpose water schemes which utilized the world's limited supply of fresh water to the best advantage.

In Britain it was already difficult to locate a new industry needing much clean water or to find inland sites with cooling water for power stations and industry. Nuclear power stations would almost certainly be sited on the coast for this reason. In this matter the engineer could help by the efficient treatment of effluents and sewage, by the re-use of water by means of cooling towers, or by returning well water used for cooling to the strata from which it had been drawn.

World's Energy Resources

Sir Harold said he ranked energy as the third great need of mankind. Here the engineer, by the increasing use of water power, was drawing on revenue and not on capital resources, though water power provided for only 4 to 5 per cent of the world's energy consumption. Other revenue resources were solar radiation, wind, tidal energy, geothermal heat and the burning of timber and vegetable products. The last source provided some 18 per cent of the total energy consumption to-day and there was not much prospect of any considerable contribution from the other revenue sources in the near future. Geothermal schemes in Italy and in New Zealand were of local importance, and the Bell Laboratory solar battery with a 10 per cent efficiency of conversion of solar radiation energy to electricity pointed the way to important developments.

The main contribution of the engineer hitherto had been the steady rise in the efficiency of combustion appliances, in the generation of electricity and in the gasification of coal. In the United Kingdom the increased demands for energy between 1920 and 1937 had been met almost entirely by increased efficiency of energy conversion and utilization, representing a saving of at least 47 million tons of coal. There was no need to stress the importance of a continued effort for higher efficiency, but fortunately the possibilities of the nuclear power station had come just when there was little prospect of large additions to the output of coal. Here was a combined operation for the electrical, chemical, mechanical and civil engineers which would add a hundredfold to the world's energy resources.

Finally, there was the engineer's conservation of human effort, both manual and mental, by mechanization, auto-

matic control and electronic computors. In the race for productivity mechanization was the pace maker. Electronic devices were much quicker and more accurate than the human brain and could be used for an infinite variety of control purposes. And whereas the human senses could only deal with one operation at a time, an electronic system could regulate simultaneously the many interlocking controls required in a large plant. The nation-wide automatic dialling system of telephones in the United States was a good example. Then analogue computors could simulate complex operating problems and provide a short cut to the answer; digital computors could solve in a few minutes differential equations which would otherwise require a prohibitive number of man-hours of work.

There was no need to dwell on the contribution of mechanization to the economies of the production line. Automatic control was another story. On the one hand, great progress had been made in the mathematical theory of control design which was directly applicable to the design of control equipment for systems in which the dynamic characteristics of the mechanisms were known. On the other hand, progress in instrumentation and in the technique of servo-mechanisms had led to the widespread application of automatic control to machines and continuous processes which were not originally designed with that in view. If the maximum advantage was to be taken of this new approach, its philosophy and theory must start in the design phase and be applied continuously. This entailed both an appreciation by the designer of its possibilities and the co-operation with him at each stage of the control engineer who had specialized in control theory and instrumentation. A big educational problem was involved which was vital to the industrial future of this country, especially now that full employment had been reached.

In the United States there were said to be close on 2,500 companies in the control business employing 8,000 graduate engineers who had specialized in this field, and there were 15,000 more in the user industries. Russia had concentrated her mathematical ability on the theory of automatic control and her numerous applications of it in industry showed how effectively she had grasped its philosophy. She was operating in 1951 the first complete automatic production line of an aluminium alloy piston from the ingot to the finished product fully tested and examined, and she had automatic plants making cylinder blocks in 1948 and also agricultural machinery. Her automatic tests of surface finish were most effective and ingenious.

He wished to draw attention to the urgent need for a more active and general recognition of the future importance of control engineering in this country. Progress to-day demanded intense specialization on the one hand and on the other the widest outlook and knowledge of what was happening in other fields. In the future the resources and skills available to mankind must be used to the best advantage, and with their unequal distribution among the countries of the world, some form of planning was ultimately inevitable, based on surveys of world resources and world needs. Only in that way could they be conserved for the use and convenience of man.

Mr. P. L. Jones proposed a vote of thanks to Sir Harold Hartley, seconded by Mr. J. Eccles, president of the Institution of Electrical Engineers.

Electrical Aspects of the Brain

AT a meeting of the Utilization Section of the Institution of Electrical Engineers on 5th May Dr. W. Grey Walter gave a lecture on "The Electrical Activity of the Brain." He said that the problem facing the physiologist or medical man was that the brain was an organ of quite fantastic complexity. There were 10,000 million nerve cells, any or all of which might be in constant communication with any or all of the others. However elaborate the measuring equipment might seem its complexity was as nothing compared to the problem which it was intended to approach.

No single recording system could possibly give enough information. A recording device or a display device was necessary which would present information on brain activity from many regions.

The tendency was towards using more and more channels of amplification and recording, 15 channels being quite common nowadays, and as many as 30, 50 and even 100 had been used simultaneously to produce a record.

Another tendency was the diminution of scale, in which the electrical engineering profession could assist by developing miniature equipment. The present epoch was in a sense the end of the classical epoch of thermionic amplification and the beginning of the new epoch of transistor amplification. The future seemed to lie in the development of an extremely small unit in which the standard equipment of, say, 20 or 30 channels would be portable in the true sense that it could be carried about by one man.

Another possible development which had not yet been exploited to any extent was the design of pocket-size equipment which a normal person under study could wear as a person wore a deaf aid. A permanent record produced in this way would enable a study to be made of brain activity during normal everyday life, which in many people was very different from that recorded while the subject was in repose on an experimental couch.

Diminution of size and simplification of design needed to be accompanied by the production of a really efficient recording system to match the transistor and its amplifier.

Dr. Grey Walter then described applications of the technique to the study of normal people and some of the equipment used.

V.H.F. TRANSMITTERS

THE Wrotham v.h.f. transmitting station, first step in the B.B.C. plan for v.h.f. coverage of Britain, opened on 2nd May. The three B.B.C. programmes are transmitted throughout the normal hours of transmission; the Home Service on 93·5 Mc/s, the Light Programme on 89·1 Mc/s, and the Third Programme on 91·3 Mc/s. The station is designed to radiate an effective power of 120 kW on each frequency and serves the London area and South East England within a range of about fifty miles.

It is expected that v.h.f. stations will be operating from Pontop Pike, Divis and Meldrum by the end of this year and that Wenvoe will be in partial operation. By the end of next year Wenvoe will be completed and further stations will be built at Sutton Coldfield, Holme Moss, Norwich, North Hessary Tor and Blaen Plwy (West Wales). This will mean that v.h.f. will be within reach of some 84 per cent of the population of the British Isles.

WORLD ELECTRICAL MARKETS

Prospects in Greece

By M. A. VERONIKIS*

DURING the thirty years after the first world war electrification in Greece did not make the great progress achieved in other countries of Europe. With the exception of the Athens-Piræus area the general conditions have not been favourable to expansion. Low productivity of the land and a low standard of living; the division of electricity supply between a great number of small undertakings; the neglect of the few national energy resources (water power and lignite), with a large consumption of expensive imported fuel; lack of capital and high interest rates, high taxes and high prices to the consumer, have been the major factors limiting the production and use of electricity in Greece.

The electrical load has been limited principally to lighting. Industrial consumption is practically concentrated around Athens and Piræus on account of the lower cost of electricity. A very small part of the industrial requirements is supplied by other utility companies outside this area. The larger industrial plants outside the capital produce their own power and some of them have constructed small hydro-electric plants to satisfy their needs.

Table I below gives some figures of the gross generation and consumption of electricity in Greece during the three years 1950-1952 in comparison with the figures for 1939.

TABLE I.—GREEK ELECTRICITY SUPPLY

	1939	1950	1951	1952
Total gross generation (million kWh) ...	310	665	745	813
Total energy delivered to consumers (million kWh)...	266	538	609	670
Consumption per head (kWh)	36	72	82	90
Industrial consumption (million kWh) ...	168	256	300	354
Consumption in Athens area (million kWh)	188	452	515	570

The country's population is about 7½ million and nearly 85 per cent of the national consumption of electricity is in the capital area with a population of about 1,450,000; the annual consumption per head in this area in the years 1950-1952 was 310-390 kWh, whereas the corresponding consumption for the rest of the country was only 14-17 kWh.

Before the second world war about 350 plants were in operation. The war and the guerilla conflict afterwards caused serious damage and in 1949 only 200 plants were operating. By the end of 1952 the number of operating plants increased to 280 with a total capacity of about 230,000 kW.

The Athens-Piræus Electricity Company (Apeco), serving by concession since 1925 within a radius of 20 km from the centre of Athens, is the only power system of appreciable size. This company owns two thermal plants working together, namely a steam plant with four 15,000 kW turbo-generators and a combined steam and diesel plant consisting of 54,000 kW of turbo-generators and 12,000 kW of diesels. The distribution system is three-phase, 50 c/s at 220/380 V. The Athens-Piræus area is the only part in Greece where reasonably adequate service is available, although the plants operate without reserves and the steadily increasing peak demand cannot always be met.

The remaining 88,000 kW of thermal electric generating capacity is scattered over the mainland and the islands as small diesel units of various sizes up to 1,000 kW, operating at various a.c. and d.c. voltages. Practically all the thermal stations burn imported fuel oil. There are also some small hydro-electric undertakings with a total generating capacity of 6,000 kW.

All these plants are operating individually, and except for a few cases, there has been no serious attempt to interconnect electrical systems. Most of the systems are operated by privately-owned companies; some are municipally owned and a few are operated by co-operative groups.

Fig. 1 illustrates the relation between installed power and generation for each of the years 1937-1952. The load factor which was nearly 27 per cent in 1939 fell to 12 per cent in 1944 but rose to over 40 per cent in 1952.

In 1950 the State-owned Public Power Corporation (P.P.C.) was founded for the supply of electricity in Greece. The electrification project was drawn up by the American firm Ebasco which was appointed manager of the Corporation for the first five years. The project was based on Marshall Aid and its cost was estimated at about 83 million American dollars for the following new plants:—

(1) The Aliveri steam-electric plant near the Aliveri mines on the island of Eubœa, burning Greek lignite, with two 40,000 kW units.

(2) The Agra hydro-electric plant on the River Vodas; two 20,000 kW sets.

* Electrical engineer, Director of the Department of Studies, Agreements and Constructions, Electricity Division, Greek Ministry of Industry.

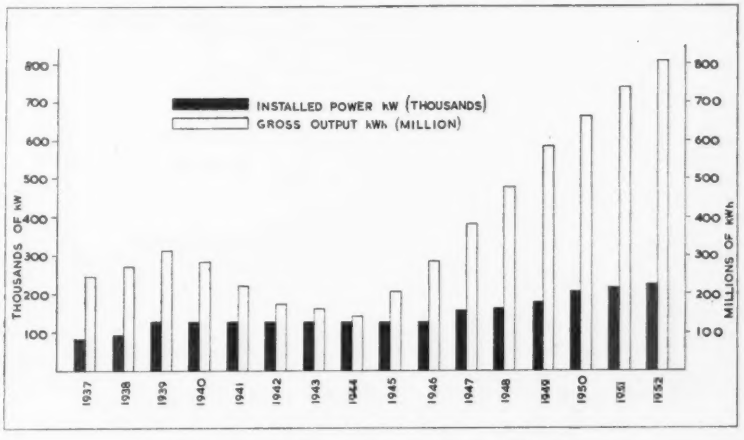


Fig. 1.—Greek plant capacity and output 1937–52

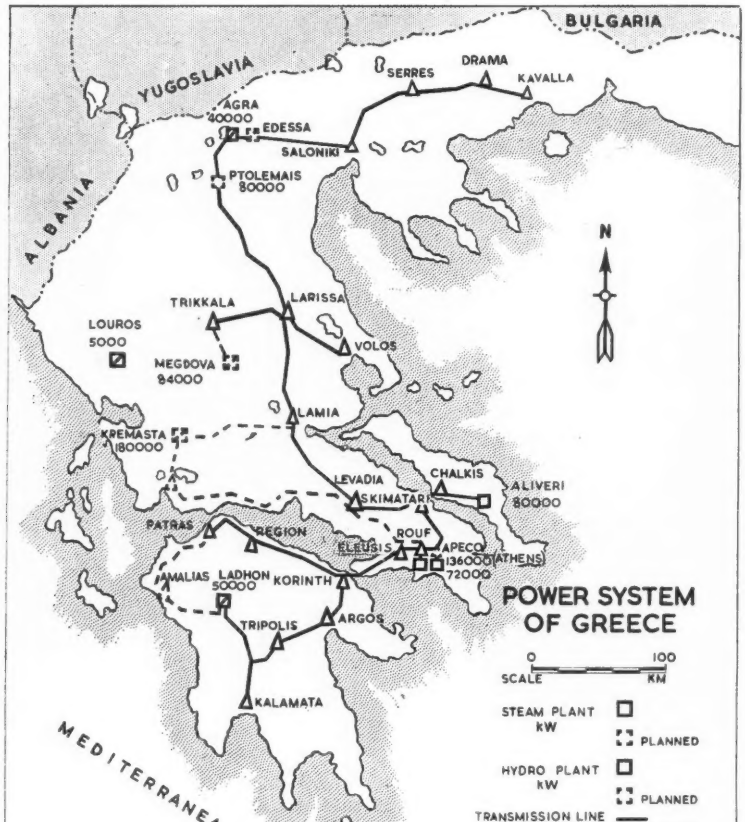


Fig. 2.—The new Greek power system

(3) A hydro-electric plant on the River Ladhon; two 25,000 kW units.

(4) A hydro-electric plant on the River Louros; two 25,000 kW sets.

In addition the electrification programme provides for the development of the lignite mines at Aliveri to give a daily output of 2,500 tons; for a suitable 150 kV transmission system with 20 substations; and for a 15 kV distribution system.

A major project elaborated by Ebasco, including the erection of a 180,000 kW hydro-electric plant on the River Acheloos with a transmission system, at a total cost of 212 million American dollars, was approved by the Greek Government, but its execution was postponed on account of the high cost.

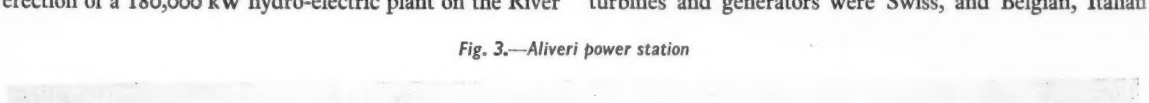
Fig. 2 indicates the plants, the 150 kV transmission lines and the substations of the first project. The plants at Aliveri, Agra and Ladhon are interconnected and linked up with the Apeco plant in the Athens area, while the Louros plant is isolated.

The Aliveri plant (Fig. 3) was put into commercial operation in November, 1953, and already supplies energy to Apeco, the Aliveri mine and the Patras area. The Louros plant (Fig. 4) started operating in April, 1954, and supplies the towns of Janina, Preveza and Arta in the Epirus district. The Agra plant was put into partial operation in October last and the Ladhon plant is practically completed.

Excluding a tie line between Larissa and Agra the 150 kV transmission system was completed in May last year. The 15 kV distribution project is in full construction and some main lines are already completed. It is estimated that after completion of the above projects the annual production of electricity per head will rise to 180 kWh.

British electrical manufacturers have had but a small share in the contracts placed for the above-mentioned works. The construction of the Aliveri plant went to Burns & Roe and the Foundation Co.; the turbo-generators and main transformers were supplied by the A.E.G., Germany, and the boiler plant by the American Babcock & Wilcox Co.; auxiliary transformers and switchgear came from Italy. As regards the Agra and Ladhon plants the general contractor was the Società Edison, Italy, and the equipment was also Italian. For the Louros plant the general contractors were Eter-Omnium Lyonnais, the turbines and generators were Swiss, and Belgian, Italian

Fig. 3.—Aliveri power station



and French companies supplied the rest of the equipment.

Messrs. Merz & McLellan were the consultants for the 150 kV transmission lines and substations but most of the material was supplied by Italian and German concerns; the English Electric Co., Ltd., provided 22 kV oil circuit breakers and some of the insulators were supplied by Doulton & Co.

It has become clear that the steadily increasing power demand in the capital area cannot be met by the surplus energy available from the P.P.C. Therefore a scheme proposed by Apeco for the extension of its thermal generating plant and distribution network was approved in June, 1954. This extension involves the installation of a 60,000 kW turbo-generator and another of 12,000 kW capacity. Boilers capable of burning both lignite and fuel oil will be installed. The general contractor and manufacturer is the English Electric Company. It is estimated that this extension will be ready for operation within three years at a cost of £7 million.

While the Ebasco project for the harnessing of water power at Kremasta, on the Acheloos River, is still pending, another scheme for the construction of a station on the River Megdova, a tributary of the Acheloos, proved to be feasible at a low cost and its execution has been made possible by credits available to the Greek Government from the French market.

The project provides for the erection of an 84,000 kW plant with an annual generating capacity of about 200 million kWh. Construction was decided upon in July last year; the cost is estimated to be about 15½ million American dollars.

The French company Omnium Lyonnais, co-operating with C.O.T.E.C.I., was entrusted with the final planning of the project and the construction. The plant will belong to the P.P.C. system and be completed by the end of 1959.

A scheme for an 80,000 kW thermal power plant at Ptolemais, in connection with the development of a lignite mine capable of supplying the quantity of lignite needed on the spot for this plant and for other industrial purposes, is contemplated. Credits for the purpose would be made available to the Greek Government from Germany.

Owing to the lack of indigenous raw material, the manufacture of electrical machinery and equipment has made little progress. According to the records of the Greek Ministry of Industry, in 1952 there were three factories producing a.c. and d.c. motors and generators of sizes up to 20 kW, covering 30-40 per cent of the country's needs. Four concerns were producing domestic electrical appliances such as heaters, boilers, ovens, irons, refrigerators, etc. This branch has made great progress in the last few years. Three works were producing electric lamps of all sizes and types and meeting most of the country's needs.

Two factories were turning out electrical porcelain. One of them, producing h.v. and l.v. insulators, has been extended recently. There were also a number of factories producing other electrical equipment such as insulated Bergman and steel tubes, Bakelite switches and plugs, lampholders, etc. The manufacture of thermoplastic insulated wires has also been begun.

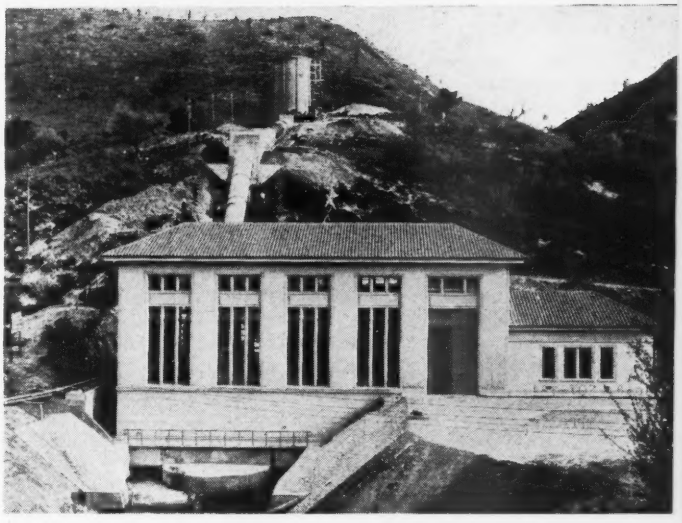


Fig. 4.—The hydro-electric plant at Louros

Export Problems

SOME of the many export problems with which we are faced to-day were referred to by Mr. J. P. Ford, managing director of three export companies of the Brush Group, Ltd., in his address at the annual general meeting of the Institute of Export, of which he is chairman, held on 4th May.

Mr. Ford said that the recently issued Economic Survey and the Chancellor's Budget speech underlined the seriousness of the balance of payments position. Trends during 1954 showed that although we exported more than ever before, imports outran our capacity to pay our way with these increased exports. We must not assume that we could increase the prices of exports in order to preserve the balance, for we were living in a world in which international competition was becoming increasingly fierce. The Institute consisted of practical export men who were becoming increasingly disturbed at the continuing demand for wage increases at a time when international competition was more and more intense. There was nothing wrong in wage increases as such, provided they were accompanied by increased productivity. If we could obtain this increased productivity, he said, then we could hope to maintain our present price levels and remain competitive in world markets.

Deliveries improved during the early months of 1954, but they were slipping once again at the end of the year. The foreign customer was not interested in our internal problems, and if we could not offer the right product at the right price and right delivery he bought from some competing nation which gave him what he was looking for. We were in a strong position as regards quality and credit, for the traditional high quality of British goods was being maintained, and exporters who were using the facilities of the Export Credits Guarantee Department were being enabled to offer periods of credit which compared favourably with those offered by foreign countries.

Markets which formerly bought even the simplest of their capital goods from the United Kingdom were now manufacturing these products themselves. Many more concerns should follow the wiser and bolder course of entering into joint venture partnerships in such territories. By adopting this procedure we would be retaining our foothold in our foreign markets and maintaining our national good-will.

He referred to the need for complete export men and said that the Institute aimed at providing for young men engaged in export trade a series of courses which would give them all the necessary theoretical training in the many and varied subjects which had to be dealt with on a day-to-day basis by the experienced export manager.

Development in 1954

E.D.A.'s Many-Sided Activities

THE thirty-fifth annual report (for the year ended 31st December last) of the British Electrical Development Association was presented at last Tuesday's annual meeting. This report is in a much improved form; for the first time it is illustrated, the pictures showing E.D.A. stands at various exhibitions, examples of E.D.A. advertisements, " stills " from E.D.A. films, and the Leatherhead Testing House. Two diagrams show the advance in the production of domestic electrical equipment.

Prefaced to the report is a list of officers and committees and references are made to these in the first page of the report. Four overseas undertakings are stated to have become contributors to the Association during the year—two in New Zealand, one in Greece and one in Belgium.

A section on editorial Press services shows that much success was obtained in the way of articles and news notes on various aspects of electrical development in the general Press and in specialized journals, particularly those appealing to women. Demonstration kitchens were established by several commercial and trade organizations.

Publicity for the electrical features of the British Industries Fair was again secured by the production of material for the Press and the Association was active in gaining the inclusion of electrical appliances in the housing section at Earls Court. The Association was again responsible for the Press publicity for the British Electrical Power Convention at Eastbourne.

Close relations have been maintained with the B.B.C. and electricity has been kept well in the forefront in radio and television programmes. Action was again taken in connection with purchase tax on domestic electrical appliances.

In March last year the Association launched a new advertising and publicity campaign with the theme " The Four Foundations of Living." It is estimated that the advertisements in national daily newspapers and in weekly and monthly journals amounted to 268 million impressions. At the same time effective industrial, agricultural and building advertising was carried on.

Film Publicity

Twenty-three new publications were issued—general, agricultural, street lighting, industrial, staff information and film catalogues. Four films were completed during the year and four others were in preparation. Copies of films lent out numbered almost 15,000 and 251 copies were purchased, raising the total to 2,659. Duplicate copies of E.D.A. films were distributed by several other organizations. Activity was also well maintained by the photographic services.

E.D.A. participated in fifteen national exhibitions of a wide variety and dealt with 10,283 inquiries received at the Building Centre, the largest number being in connection with electric heating.

The Rural Electrification Advisory Committee inaugurated a scheme by which E.D.A. models will be made available to universities and colleges which provide degree or national diploma courses in agriculture and horticulture. Brief particulars are given in the report of rural electrification courses organized during the year and of the activities of mobile workshop units. Exhibits were arranged at most of the important agricultural and allied shows held in 1954.

The Industrial Development Committee held its first meeting in December, when Mr. L. Howles was appointed chairman and Mr. J. F. Smith, vice-chairman. Mr. Smith also became chairman of an Industrial Electro-Heat Sub-Committee. There was much activity in various branches of industrial engineering including plant layout, materials handling and processing, instrumentation and control, lighting, fuel technology, heating and ventilation, and the human factors in industry. Liaison was maintained with a number of industrial associations and other organizations.

There was a continued demand by housing authorities, architects and surveyors for E.D.A. literature and advice. A booklet was produced in connection with the Government's scheme for the improvement or conversion of older houses. Increased interest was shown in the electric heating of buildings, particularly by heat-storage methods.

Electricity and Fuel Economy

Trials were made of two heat pumps and representations were made to the Government on the subject of purchase-tax on these appliances on the ground of fuel economy. Reference is made to the E.D.A. " List of Domestic Electrical Appliances," now confined to types suitable for local authority housing schemes. Matters considered by the Electrical Appliances Committee included a survey of the adequacy of wiring installations in local authority housing.

Among other subjects the Cooking Sub-Committee considered the terms of hire and hire-purchase schemes and delays in delivery caused in some cases by the greatly increased demand for radiant boiling plates. Consideration was given by the Water Heating and Laundry Equipment Sub-Committee to a preliminary investigation into the technical and commercial possibilities of combining night-time water heating with night-time space heating in houses and flats. Meetings took place with members of the Electric Water Heater Manufacturers' Association to discuss general development and, in particular, the possibilities of low-cost water heaters.

The Refrigeration Sub-Committee decided that a supplementary section dealing with freezing facilities in the home should be prepared for the E.D.A. " Refrigerator Handbook." A draft code of minimum requirements for electrically-heated commercial catering appliances and the problems connected with the interchangeability of boiling plates and grill elements were considered by the E.D.A./B.E.A.M.A. Commercial Catering Committee.

The booklet " A Matter of Life and Death," putting the case for adequate street lighting, was produced under the auspices of the Street Lighting Committee which also discussed a number of electrical problems, including a new draft code of practice.

The Trolley-bus and Tramways Committee worked in close co-operation with the B.E.A.M.A. during the year. Its activities included the showing of films on the handling of passenger traffic in America; assistance in connection with a course of twenty-four lectures on electric traction at the Borough Polytechnic, London; and persuading the Minister of Transport to agree to the building of a 30ft trolley-bus with two axles instead of three.

Last year was the first full year of operation of the Testing House at Leatherhead. There was a marked increase in the number of reports issued—172 on new

appliances and 43 addenda to previous reports. Altogether 230 appliances with special problems were investigated, including 37 for the E.D.A./B.S.I. Advisory Committee on Electrical Appliances and Accessories and seven for the Canadian Standards Association Approvals Agency. Mention is made of the difficulties of obtaining suitable technical staff for the Testing House, with consequent retardation of its work.

Educational activities referred to include the Annual Conference, the E.D.A./E.A.W. Conference, the public speaking competition, the salesmanship course and assistance to schools and institutions.

Notes on the work of the Electric Vehicle Association and the Electrical Association for Women are appended to the report.

ANNUAL LUNCHEON AND MEETING

The annual luncheon took place at the Savoy Hotel, London, on Tuesday last, with Sir John Hacking, M.I.E.E. (president), in the chair.

The toast of "Electrical Development" was proposed by Earl Jowitt and responded to by Sir John Hacking, who also proposed the health of the guests. Lt.-Comdr. the Hon. L. W. Joynson-Hicks, Parliamentary Secretary to the Ministry of Fuel and Power, replied on the guests' behalf. A further report will appear in next week's issue.

At the subsequent annual meeting, at which Mr. S. F. Steward, the chairman, presided, it was announced that Viscount Chandos had consented to act as president for the ensuing year, that Lord Hurcomb had been reappointed a vice-president, and that Mr. Thomas Johnston had been appointed a vice-president. Votes of thanks were passed to Sir John Hacking (proposed by the chairman and seconded by Mr. C. T. Melling), to Mr. Steward (proposed by Mr. C. R. King, seconded by Sir Henry Self), to the chairmen and members of E.D.A. Committees and the technical Press, and to Mr. V. W. Dale, director and secretary, and his staff.

The new president of E.D.A. is Viscount Chandos (left). Mr. C. R. King (right) is chairman for 1955–56

The new chairman of the Association is Mr. C. R. King who is the chairman of the East Midlands Electricity Board.

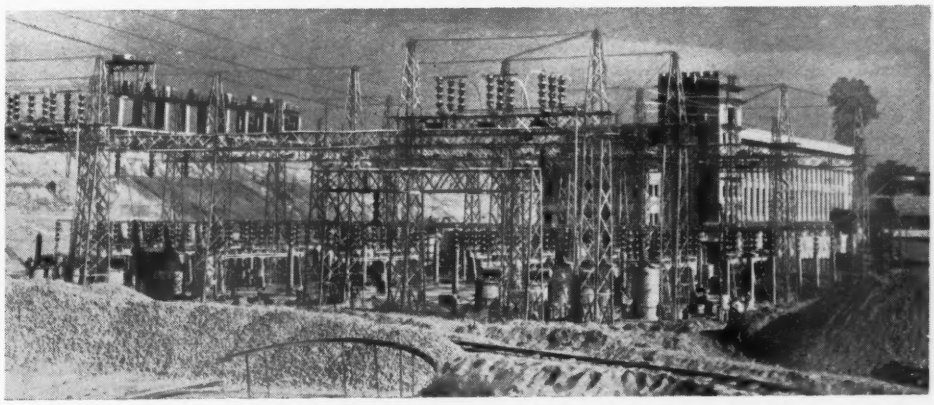
The Sarda River Project

THE Sarda Canal system (India) of which Khatima power house is a development, was the idea of a Briton, Captain Forbes, who some 70 years ago, before the advent of railways and roads, traversed and surveyed miles of dense and formidable jungle in order to investigate the possibilities of harnessing the Sarda River for the purposes of irrigation.

The headworks of the Sarda irrigation system are situated at Banbasa in the north of the Province of Uttar Pradesh on the borders of Nepal. The flow in the main canal is seasonal with a maximum capacity of 9,500 cusecs. The site of the power station is several miles from Banbasa at Lohia Head, where the available head is 60ft distributed over some eighteen open falls varying between 2ft and 5ft. The water supply for the power station takes off from the main canal at mile 8 near the village of Khatima from which the power house takes its name, and the diversion rejoins the main canal at mile 20.

The English Electric Co., Ltd., has been given the main contract to supply and erect all plant and equipment for the power house, intake hydraulic equipment, discharge regulators and outdoor switching station, one of the most comprehensive contracts which it has undertaken.

Electrical energy generated at Khatima is intended to provide a means of tubewell irrigation as a supplement to the original Sarda Canal over areas so far not served by the canal, while the station will be linked with the thermal power stations at Lucknow and with the existing Ganga power system. The power available will provide a much needed stimulus to cottage industries and others in the vast and comparatively undeveloped tracts of Kumaon, Oudh and Rohilkand.



The Khatima power house and switching station in Uttar Pradesh, India

VIEWS on the NEWS

By REFLECTOR

IT was implied in a question put to the Minister of Labour in the House of Commons last week that some extraordinary inducements are being offered by American concerns to electronic engineers. Not only are they being tempted by higher salaries than are customarily paid by British employers, but they are being offered "modern domestic accommodation." As if this wasn't enough there is extra bait; they are promised facilities for fishing and sailing. No doubt if their tastes did not lie in that direction they could secure such alternatives as winter sports. There is, however, a more serious side to this question. We cannot afford to lose men qualified in electronic engineering and if we are to keep them they must be generously treated.

* * *

It seems that in these days if you are prepared to wait long enough you get what you need for nothing. The *Newcastle Journal* reports that over thirty local Council tenants at Prudhoe have petitioned the Council about having to pay for their electrical installations while the remainder of the houses in the street are being wired free of charge. Several years ago, it is explained, the Council could not get grants to cover this work but permitted the tenants to have electricity installed at their own cost. Now grants are made for the work and it is being done gratis for those who waited. Apparently the grants are not retrospective and all a Council official could say was:—"If the complaining people had waited they would have got the work done for nothing as well." This is cold comfort for those who, after all, improved the Council's property.

* * *

It is easy to spend money during visits to the Continent and a constant worry whether the currency will hold out. Yet it is rarely that one can get rid of all the foreign coinage or notes before returning and the banks do not want odd small amounts. It is suggested that electrical people who find themselves with this un-negotiable currency should not keep it until their next Continental trip but send it along to the Electrical Industries Benevolent Association (32, Old Burlington Street, London, W.1) which has made a special arrangement for getting it changed into sterling. Possibly those concerned will feel disposed to send also one or two notes of larger denomination which they may have left over.

* * *

Because it maintains that sodium-vapour street lighting is more efficient and cheaper than other forms of illumination the Hendon Council purposes to install it in Mill Hill, a pleasant district on the outskirts of London. Some residents object because, they say, sodium lighting destroys colour and they prefer filament lamps. The Mill Hill Preservation Society has even gone to the British Electrical Development Association (according to the *Manchester Guardian*) and has been given figures showing that other forms of residential lighting are available at comparable cost. Presumably "other forms" means fluorescent lighting, which is economical and has better colour-rendering properties. The Society questions the "moral right" of the Council to use lighting that is "distasteful to so many residents."

* * *

Another objector to sodium lighting is Lord Kinross who is stated by the *St. Marylebone Record* to have accompanied his cheque for rates with a protest "in view of the Council's policy of installing indiscriminately throughout the borough sodium street lamps, a form of colourless lighting totally unsuitable to a residential area."

Many people, of course, like sodium lighting. What are local councils to do? Conduct a referendum?

* * *

Whether they have been influenced by the well-known interlude sequence of the B.B.C. television service or by something else I cannot say, but it is evident that the number of amateur potters has grown considerably. Tuition in the art is being given at many of the London County Council's educational institutions and I am pleased to hear that for pottery firing electric kilns seem to be in favour. It is reported that eighteen new secondary schools are to have them, in addition to ten existing establishments.

* * *

The slide rule takes many forms and is adapted to the particular purposes of many industries and professions. A very unusual type is reported to have appeared in an inventors' exhibition in Paris recently. With this slide rule, it was claimed, it was possible to conjugate all French irregular verbs. I am not at all sure that open linguistic calculation is an improvement upon the furtive glance at a phrase book, but the device should have a good sale among schoolchildren if this form of "crib" can be successfully concealed.

* * *

The malpractices of the "jerry wirer" formed the subject of an article and comment in the *Electrical Review* of 10th May, 1895. Calling for immediate and adequate remedies an editorial note said:—

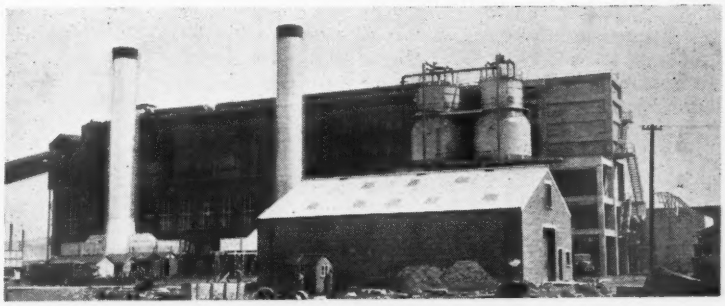
> "It is satisfactory to find the Institution of Electrical Engineers is really alive to the necessity of providing some rules that can be understood, but . . . the Institution have, unfortunately, no power to compel a person to work to a proper standard. What is wanted is a stringent inspection and strict supervision, and to this end the efforts of electrical men should be mainly directed."

Now, sixty years later, the problem is still with us, although perhaps in not quite so bad a form. At last we have a National Inspection Council and maybe things will begin to improve when it gets going.

New Power Station for Belfast

Official Opening by Lord Wakehurst

ON Friday last the new Belfast Municipal Electric Power Station West was officially commissioned by the Governor of Northern Ireland, Lord Wakehurst, K.C.M.G. The principal source of local generation in Belfast up to the present has been the Power Station East which was commissioned in August, 1923, and which has a present capacity of 174,750 kW. Supply is also drawn from the system of the Electricity Board for Northern Ireland. The new power station comprises an initial installation of four 180,000 lb per hour boilers delivering steam at a pressure of 650 lb per sq in and at a temperature of 925 deg F to two 30,000 kW turbo-alternators. The first extension planned will comprise seven 220,000 lb per hour boilers operating at 950 lb per sq in and 925 deg F and two 60,000 kW turbo-alternators; and a second extension later will have two similar boilers and one 60,000 kW turbo-alternator. The ultimate capacity will thus be 240,000 kW.



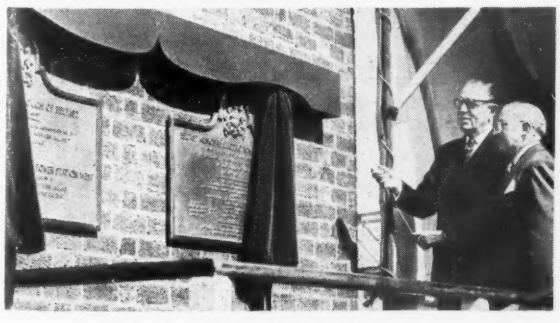
General view of power station

The site chosen for the new power station is suitable for the direct unloading of coal from large boats, is close to the load centre and has an adequate supply of sea water for cooling, the consumption of cooling water in each of the initial machines being over 21,000 gallons per minute. The daily consumption of coal is estimated at 510 tons for the initial installation on 70 per cent load factor.

The site chosen, although having the above advantages, did not have a suitable sub-soil for simple foundations and extensive piling had to be undertaken. This involved the removal of some 630,000 cu ft of spoil and in all a total of 1,888 piles of the pre-cast type was driven, 14in square in section and varying in length from 45 to 50ft. The steel framework of the building, which is 206ft long, 195ft wide and 105ft high, has been clothed with rustic bricks to enhance the appearance.

From the pump house, concrete culverts have been built below ground level to convey the circulating water to the condensers and thence to a cascaded outfall on the bank of the Victoria Channel. This outfall has been designed to limit the velocity of the water to a maximum of 0·75 knot, to avoid interfering with shipping in the vicinity.

When the various extensions are completed the coal requirements will be 2,000 tons a day and the coal handling plant has been designed to meet this requirement. All coal supplies will be seaborne and a special jetty has been built by the Belfast Harbour Commissioners to accommodate two of the modern type of collier and four unloading cranes. Two of these cranes have now been installed and each has a maximum handling capacity at the break of the cargo of 150 tons of coal per hour and an average capacity throughout the discharge of the boat of 75 tons per hour. The high discharge rates have been achieved by incorporating in the crane structure a receiving hopper and belt conveyor. These make slewing unnecessary except for parking and only the luffing, hoisting and lowering motions are normally used. Each integral belt conveyor discharges the coal on to two conveyors which run the full length of the jetty. These conveyors deliver it to further conveyors for direct transmission to the boiler house bunkers or on to a stocking-out conveyor which in turn supplies a transporter spanning the coal storage area. This transporter, which will eventually build up a stock of 40,000 tons of coal, has a span of 200ft and an average handling capacity of 300 tons per hour. A substantial reserve stock of coal will also be built up alongside the east rail of the transporter. This coal will be handled by bulldozers and a conveyor yet to be installed. The conveying system incorporates automatic coal weighing machines and screening and crushing plant.



Lord Wakehurst performing the official commissioning

The boilers are of the tri-drum type having two upper steam and water drums and one lower water drum interconnected by two weldless steel tubes. Coal is burnt on Babcock & Wilcox style 28 twin stokers, 32ft wide and 20ft long giving an effective grate area of 640 sq ft. An economizer raises the feed water temperature to 442 deg F and air heaters raise the temperature of the combustion air and reduce the final gas temperature to about 300 deg F. The air heaters are of the rotary regenerative type. Two forced draught fans, two induced draught fans and two secondary air fans are provided per boiler.

For ash disposal a high pressure sluicing plant is provided, ash being removed hydraulically from storage hoppers at the rear of the chain grate stokers and deposited into a sump situated in the ash plant house. Suitably positioned high pressure water jets force the ashes to travel from the hoppers along sluiceways in the floor of the boiler house basement. These are lined with nickel/cast iron

plates to resist the abrasive action to which they will be subjected. Before entering the sump the ash is ground so that it can be efficiently dealt with by pumps which pump the mixture of ground ash and water to three concrete storage bunkers. From these the water is drained off to be re-used for pumping and the relatively dry ash is delivered by gravity to lorries for removal from the site.

The dust and grit which are extracted from the flue gases and the fine ash and riddlings which fall through the chain grates of the stokers are stored in local steel hoppers pending removal by the dust handling plant. This plant, which is adjacent to the ash plant, consists of eight-stage turbine exhausters each of which is capable of providing means for the conveyance of 7 tons of dust per hour. The dust, etc., is conveyed through pipes of abrasive resistant material to storage hoppers each having a capacity of 60 tons. As the dust is removed from these hoppers for cartage from the site it is water sprayed in a mixer conveyor while being discharged into the trucks.

The turbines are two cylinder machines coupled in line to the generator. The low pressure cylinder exhausts into a single three-flow condenser with a surface of 30,000 sq ft. The generators are 3,000 r.p.m., 11,800 V machines. The generating voltage is stepped up to 33 kV by unit transformers and is taken to a 33 kV substation in an electrical annexe to the power station, where 1,500 MVA small-oil-volume circuit-breakers are used, operated by motor charged spring closing mechanisms from the main control room.

The circuit-breaker compartments, which are the height of the building, are arranged in two rows on either side of the building. Between them and a central corridor are the cable sealing-end chambers which also contain the current and voltage transformers. The isolator and circuit-breaker control cubicles are also mounted within these chambers with access from the central corridor, from which the circuit breaker and each isolator associated with it can be operated. Interlocks are incorporated in the control cubicles. Above the cable sealing-end chambers and the central corridor there are the two busbar chambers arranged on two separate floors. The bare copper tubular busbars are carried on shedded porcelain insulator supports with clamped connections taken therefrom to the associated isolators.

Down the centre of each busbar chamber there is an access corridor, formed by two expanded-metal screens, so that busbars while alive, and their insulators, can be inspected at any time in perfect safety. The cable sealing-end chambers have inspection windows so that all the equipment in those chambers can also be inspected, and each circuit-breaker chamber also has an inspection window at about normal eye level. Opposite the busbar isolators there is a special gallery with large inspection windows from which the isolators can be readily inspected.

The principal plant contractors were:—Boilers—Clarke, Chapman & Co., Ltd.; generating plant and transformers—C. A. Parsons & Co., Ltd.; switchgear—A. Revrolle & Co., Ltd., and the English Electric Co., Ltd.; boiler feed pumps—Mather & Platt, Ltd.; circulating water pumps—Gwynnes Pumps, Ltd.; coal handling plant—Mitchell Engineering, Ltd.; coal unloading cranes—Clyde Crane & Booth, Ltd.; ash and dust handling plants—John Thompson Industrial Constructions, Ltd.; main cabling—W. T. Henley's Telegraph Works Co., Ltd.

Power for New Industries

At the luncheon following the commissioning of the new station, Lord Wakehurst said that the story of the growth of Belfast's electricity undertaking showed that tremendous development had taken place since 1895, when the lighting was switched on in Belfast for the first time. Northern Ireland would derive immense benefit from the new source of power. He had no doubt that this enterprise would be an important factor in the effort to attract new industries, increase the volume of employment, and strengthen the economic structure of Northern Ireland.

Sir Claude Gibb, chairman and managing director of C. A. Parsons & Co., Ltd., said in the course of his speech that because of the deficiency of coal in Northern Ireland this would undoubtedly be a field for the establishment of a nuclear power station. It was often said that Britain, whilst leading in research, lagged in the application of that research; but in the nuclear field that was not the case.

Floodlighting in France

In a lecture on "The Illuminated Chateaux of France" given at a meeting of the Illuminating Engineering Society in London on 10th May, M. Jean J. Chappat spoke of the development of interest in floodlighting in France. In 1937, as a result of a campaign by lighting interests, some 500 buildings in provincial cities and villages were floodlit. After the war interest in floodlighting revived and in 1951 many of the chateaux were floodlit for the first time.

In 1952 the first "Sound and Light" display took place at the chateau of Chambord. The cost of the installation was 15 million francs, all of which was recovered during the first year when some 150,000 spectators visited the chateau. In 1953 a "Sound and Light" spectacle was arranged at Versailles and others rapidly followed. There were now nearly 20 such lighting displays every summer evening.

The remainder of the paper dealt with the techniques used in these installations, the importance of long range projectors being stressed. Great use was made of coloured light which was obtained by tinted reflectors rather than by the use of coloured screens over the projectors.

M. Chappat pointed out that though the cost was high, the displays had become an important feature of tourism in France and there was no doubt that they paid for themselves within a very short time. An impression of one of them was given by using coloured slides and playing actual stereophonic recordings of parts of the sound programmes. The stereophonic reproduction apparatus used at the lecture was lent by Electric & Musical Industries, Ltd.

Telegraph Codes

An informal lecture on telegraph codes was given by Mr. H. V. Higgitt before the Institution of Electrical Engineers' Radio Section on 2nd May. He considered that the short-long Morse code was likely to survive where manual reception was required. The cable code, which also existed still, used the same permutations of two elements (dot-dash).

Reception by automatic printers introduced equal-length codes. Baudot's 5-unit binary code (1870) was internationally accepted, but required a case-shift. It was, however, too well established to be replaced by the 6-unit code which needed no case shift. Most long submarine cables still used the ternary cable code, though many had been changed to 5-unit working. The 5-unit signals, although transmitted as a binary code of plus and minus voltage, had to be received as ternary signals of plus, zero and minus current to avoid loss of speed. The change from binary and ternary also took place when sending short-long Morse signals through a long cable, a vibrating relay normally being used to restore the binary signals. Practical work on codes in recent years had been largely associated with transformations to, from or between the international Morse code and the international 5-unit code. Examples were the sending of the Morse code over a 5-unit channel and of a 5-unit over a cable-code channel.

PERSONAL AND SOCIAL

News of Men and Women of the Industry

Sir Edward Appleton, G.B.E., K.C.B., F.R.S., has accepted an invitation to become president of the Radio Industry Council in succession to **Lord Burghley,** who has held office since 1952. Sir Edward, the distinguished scientist whose research work in the field of radio-physics was largely responsible for the development of radar, was awarded the Nobel Prize for Physics in 1947. He has been principal and vice-chancellor of Edinburgh University since 1949 and for ten years before that appointment was secretary of the Department of Scientific and Industrial Research. He was the 1953 president of the British Association.

Mr. H. G. Harlow, B.Sc., M.I.E.E., who has been manager of the Leeds office of the British Thomson-Houston Co., Ltd., since 1948, is taking over the managership of Newcastle district office from 16th May. He is succeeded by **Mr. W. J. Wilson,** A.M.I.E.E., who has been assistant manager at Leeds since April, 1954.

After early education at the Merchant Venturers' School, Bristol, Mr. Harlow went on to Bristol University, graduating in 1920 with the B.Sc. degree in electrical engineering. During the 1914-18 war he served in the Royal Engineers. He joined the B.T.H. Co. in 1920 and entered the Design Engineering Department in 1922, later transferring to the Supply Department (now Industrial Machines Department) as a commercial engineer. In 1932 he joined the London power sales staff, remaining there until being appointed manager at Leeds.

Mr. Wilson was educated at Acton and Chiswick Polytechnic and Acton Technical College before commencing his apprenticeship at the B.T.H. Willesden switchgear works. After periods in the drawing office, tender engineers, and Switchgear Contracts Department he moved to the company's Sheffield office in 1950, remaining there until 1953 when he was transferred to Manchester. He went to Leeds as assistant manager in the following year. **Mr. S. J. Clarke** is relinquishing the managership of the Newcastle district office before taking up another appointment in the company.

Mr. H. G. Harlow

Mr. W. J. Wilson

Mr. S. Raybould, A.M.I.E.E., manager of the Wednesbury and Bilston District of the Midlands Electricity Board, has been appointed manager of the Board's Central Gloucestershire Sub-Area, to fill the vacancy caused by the transfer of Mr. D. Holt, B.Sc. (Tech.), M.I.E.E., to the managership of the Wolverhampton and District Sub-Area. Mr. Raybould, whose appointment takes effect on 23rd May, was born at Handsworth, Birmingham, in 1907 and was educated at Bridge Trust Grammar School, Birmingham. He was a student apprentice with the former Shropshire, Worcestershire and Staffordshire Electrical Power Co., and he remained in the service of that company until the formation of the Midlands Electricity Board in 1948.

Mr. S. Raybould

From 1935 to 1943 he was chief transmission and distribution operation engineer. In 1943 he became technical assistant to the general manager of the S.W.S. Electric Power Co., Mr. D. H. Kendon, remaining in this post until his appointment in 1945 as district manager at Dudley, Worcs. In 1948 Mr. Raybould was appointed northern divisional engineer, retaining this appointment until vesting date. During his service with the Midlands Electricity Board Mr. Raybould has been deputy district manager at West Bromwich, becoming manager of that district in 1949. In 1953 he took up the appointment at Wednesbury which he is now relinquishing.

Mr. C. F. B. Hippisley has been appointed London sales manager to Brown, Lenox & Co., Ltd. For the past twenty years he has been with the Morgan Crucible Co., Ltd.

Mr. E. C. Willis, F.C.I.S., manager of Bristol Sub-Area of the South Western Electricity Board, was presented with a long service award by the Board's chairman, Mr. S. F. Steward, on 5th May. Mr. Willis joined the Bristol Corporation Electricity Department in 1919. He was appointed secretary to the general manager (Mr. Faraday Proctor) in 1929; secretary to the Electricity Committee of Bristol Corporation in 1933; secretary and sales manager of the undertaking in March, 1945, and general manager in October, 1945.

Mr. E. L. Wildy, managing director of the Liverpool Electric Cable Co., together with Mrs. Wildy, attended a ceremony at the Bootle Works on 27th April at which awards for long service were presented. Mr. A. Squire and Mr. J. Catherwood, both of whom retired last year, and Mr. T. Rogers were presented with gold pocket watches in recognition of fifty years' service with the company. In addition, eight other employees received long service certificates and awards for twenty-five years' service. Mr. J. R. Cox (director), who was one of the recipients of the twenty-five years' certificate, thanked Mr. and Mrs. Wildy for attending, and Mr. J. Catherwood responded on behalf of all the long service employees.

Dr. H. D. Einhorn, A.M.I.E.E., M.(S.A.)I.E.E., senior lecturer in electrical engineering, University of Cape Town, is at present in this country and he recently visited the works of the Benjamin Electric, Ltd., where he saw lighting fittings being manufactured for use in South Africa. In the accompanying picture he is seen with Mr. J. Studholme, chief technical engineer of the Benjamin Electric, in the engineering research laboratory.

Dr. H. D. Einhorn, of Cape Town (right) with Mr. J. Studholme (chief technical engineer) in the engineering research laboratory of the Benjamin Electric, Ltd.

The Midlands Area Regional Competition of the **E.I.B.A. National Golf Championship** will take place at the Edgbaston Golf Club, Birmingham, on 8th June. Application forms can be obtained from the hon. secretary, Mr. B. R. Fletcher, 181, Queens Road, Yardley, Birmingham, 26, or the

hon. competition secretary, Mr. G. Redmond, Cryselco, Ltd., 99-100, Charlotte Street, Birmingham, 3.

Mr. D. C. Field, B.A., M.I.E.E., A.M.I.C.E., assistant chief engineer (design and planning), South Eastern Electricity Board, has retired owing to ill-health after nearly thirty years in the electricity supply industry. Mr. Field joined the Yorkshire Electric Power Co. from the British Thomson-Houston Co., early in 1925, and in 1939 became assistant chief engineer with the Wessex Electricity Co. He joined Seeboard at vesting day.

Mr. C. Ryder, M.I.E.E., was appointed chief engineer, Instrument and Meter Department, of the Metropolitan-Vickers Electrical Co., Ltd., on 1st March last, succeeding **Mr. T. W. Ross,** M.I.E.E., who has been appointed consultant to the chief electrical engineer of the company. Mr. Ryder, who is an Associate of the Manchester College of Technology, joined the company in 1919 as a draughtsman in the Instrument and Meter Department. In 1921 he was transferred to the engineering side dealing with automatic control schemes, and since 1929 he has been responsible for the design and development of protective and control relays. He was appointed assistant chief

Mr. C. Ryder

Mr. J. C. Dawson

engineer in 1950. He is a member of several B.E.A.M.A. and B.S.I. technical committees and of the I.E.E. Measurements Section Committee. During the 1952-53 session he was chairman of the I.E.E. North-Western Measurements Group. He is joint author of a number of I.E.E. papers on protective gear and has written a number of articles for the technical press.

Mr. J. C. Dawson, B.Sc., A.M.I.E.E., has been appointed assistant sales manager, Switchgear Department, of M-V. He took his degree at Birmingham University and joined M-V as a probationary college apprentice in 1934. From 1940 to 1945 he was seconded to the Admiralty as an experimental officer specializing in anti-magnetic mine devices. On completing his apprenticeship, which was interrupted by the war, he joined the Traction Control Engineering Department. In 1948 he transferred to the Traction Sales Department.

On Friday last an interesting ceremony took place on the stand of Wm. McGeoch & Co., Ltd., at the British Industries Fair, Castle Bromwich, when the Lord Mayor of Birmingham presented, on behalf of the company, a cheque to **Mr. Harry Jinks,** in recognition of his long service. Mr. Jinks, who is in his 86th year, recently retired from the company after 65 years' service. His last job was that of brass dresser, and before that he was engaged on ships' brass foundry, railway carriage work and the dressing of various types of electrical equipment.

The Lord Mayor of Birmingham, accompanied by the Mayoress, presenting a cheque to Mr. Harry Jinks. Mr. W. Percy McGeoch, works managing director, is on the left

Mr. R. C. Bird, managing director of Petbow, Ltd., will arrive in Toronto about a fortnight before the opening of the Canadian International Trade Fair and will take charge of the company's stand during the exhibition. After the Fair he will travel through Canada with a view to studying the Canadian market in relation to the company's products.

The Minister of Fuel and Power has accepted the resignation of **Mr. H. G. Partridge,** M.A., from part-time membership of the South Wales Electricity Board on his becoming a candidate at the forthcoming General Election.

Mr. R. W. Bassil, A.M.I.E.E., has been appointed superintendent of the Deptford West generating station in succession to **Mr. G. H. Whelton,** who retires this month. After training at Faraday House, Mr. Bassil commenced at the Grove Road station of the Central Electric Supply Co., Ltd., in 1921 and in 1928 was transferred to Deptford West as boiler house superintendent, being promoted to deputy superintendent in 1946.

Mr. D. S. Cumberlege retired from the position of legal adviser to the Southern Electricity Board at the end of April. He had occupied that post since vesting day, having previously been legal adviser to the Electricity Commissioners since 1930. He is a barrister-at-law. Upon his retirement

Mr. R. R. B. Brown presenting a silver tray to Mr. D. S. Cumberlege

Mr. Cumberlege was presented by Mr. R. R. B. Brown, chairman of the Southern Board, with a beautiful George II silver tray.

Mr. H. G. Palfreman, sales manager of Bill Switchgear, Ltd., has also been appointed secretary of the company.

Mr. H. T. Ramsay, M.Sc., M.I.E.E., F.Inst.P., has been appointed director of the Safety in Mines Research Establishment of the Ministry of Fuel and Power. He succeeds **Mr. A. H. A. Wynn,** M.A.(Cantab.), M.I.Min.E., who resigned on his appointment to membership of the National Coal Board.

Mr. Ramsay was born in 1907 and graduated from London University in 1932. For much of his career he served under the late Sir Clifford Paterson at the G.E.C. Research Laboratories, working on the application of discharges in gases to high-voltage rectification and related projects. In 1939 this work was found to have applications to radar and his group worked on these problems throughout the war. In 1944 he was appointed to the leading staff of the laboratories and in 1948 he left the G.E.C. to join the Armaments Department of the Royal Aircraft Establishment, where he worked on problems of fighter armament.

In 1949 Mr. Ramsay moved to guided missile developments where he led a group studying associated analytical and electro-mechanical problems. Early in 1953 he went to the headquarters of the Ministry of Supply to supervise a group of major industrial projects associated with this work. He joined the Ministry of Fuel and Power last year and was appointed to the Safety in Mines Research Establishment.

OBITUARY

Mr. B. F. McMurtrie.—The death occurred on 20th April in South Africa, at the age of seventy-five, of Mr. Basil Flexman McMurtrie. Mr. McMurtrie was born in Frome, Somerset. After serving an apprenticeship at the Highbridge Works of the Midland Railway Co., he went in 1901 to the General Electric Co., Schenectady. In 1904 he

returned to England and joined the British Thomson-Houston Co., Ltd., forming a new department dealing with foreign contracts, which later became the Export Department. In 1906 he went to India and for three years travelled in the Far East in the interests of the company. He returned to Rugby in 1909 and was appointed manager of the Export Department. In the 1914-18 war he saw active service in France and Italy and was decorated with the O.B.E. (Military Division), Belgian Croix de Guerre, Italian Croce di Guerra, and was three times mentioned in dispatches. Returning to Rugby after the war he continued as manager of the Export Department until 1934, when on medical advice he relinquished his position with the B.T.H. Co. On regaining his health he took up a position with the Island Trading Co., Ltd. During the last war Mr. McMurtrie was an army welfare officer. He was then with the B.T.H. again until 1945, when he finally retired and went to live in South Africa.

The Earl of Gowrie, who amongst his many other activities, was vice-chairman of Siemens Brothers & Co., Ltd., died on 2nd May at the age of eighty-two. He had a distinguished military career from 1891 to 1928, and in the last mentioned year became Governor of South Australia. In 1935 he was Governor of New South Wales, and from 1936 to 1944 was Governor-General of Australia.

Mr. H. G. Bennett.—We are informed by the Trafalgar Engineering Co., Ltd., London, that their founder and managing director, Mr. H. G. Bennett, died on 6th May at his home in Sussex. Mr. Bennett was also a director of the Gothic Engineering Co., Ltd., West Bromwich. A memorial service is to be held at the Church of St. Dunstan-in-the-West, Fleet Street, London, at 12.30 p.m. on 23rd May.

Mr. H. F. Downing, sales manager at the branch at 38, Newman Street, W.1, of the Phœnix Telephone & Electric Works, Ltd., died on 12th April at the age of fifty-two. Mr. Downing joined the company nearly twenty-five years ago.

Mr. R. P. Hilton.—The death occurred recently of Mr. R. P. Hilton, A.M.I.E.E., manager of Cobra (Wood Treatment), Ltd.

WILLS

Mr. W. G. Hodgson, A.M.I.E.E., formerly managing director, W. G. Hodgson & Co., Ltd., who died on 22nd October last, left £5,715 gross (£5,632 net).

Mr. W. A. H. Parker, M.I.E.E., electrical consultant to the National Farmers' Union, who died on 15th January last, left £4,263 gross (£4,020 net).

Mr. K. H. Shipton, B.Sc., A.M.I.E.E., deputy chief engineer in the Switchgear Department of South Wales Switchgear, Ltd., who died on 30th January last, left £2,894 gross (£2,854 net).

Mr. E. P. Lucking, M.I.E.E., former manager of the London and district sales office of George Ellison, Ltd., who died on 9th December last, left £15,892 gross (£15,775 net).

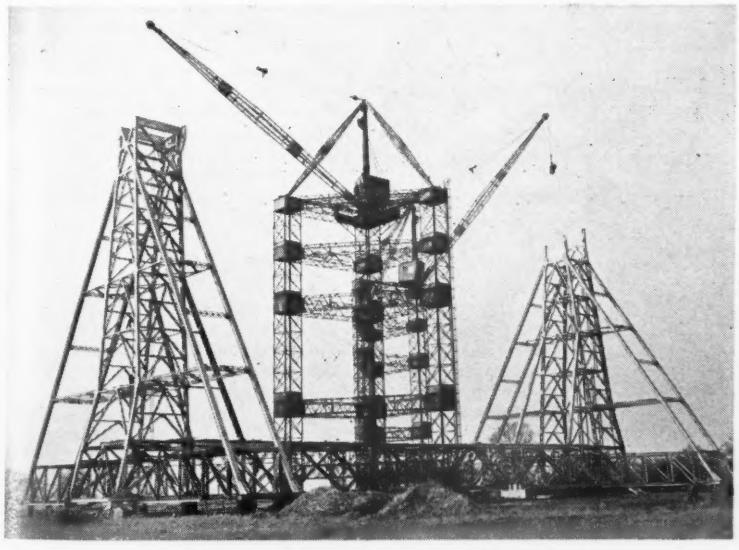
Mr. J. T. Graham, O.B.E., A.R.T.C., M.I.Mech.E., assistant managing director of Worthington-Simpson, Ltd., who died on 4th December last, left £18,397 gross (£14,141 net).

Mr. J. Boon, superintendent of the Great Yarmouth power station, who died on 8th February last, intestate, left £5,707 gross (£5,219 net).

Mr. E. D. Spencer, A.M.I.E.E., formerly chief engineer to Taylor Tunnicliff and Co., Ltd., who died on 18th February last, left £2,360 gross (£2,283 net).

Mr. H. W. Walker, M.I.E.E., who died on 11th November last, left £28,944 gross (£27,481 net).

Mr. B. H. S. Jennings, export manager of Standard Telephones and Cables, Ltd., who died on 10th February last, left £5,989 gross (£5,938 net).



Radio telescope under construction at Jodrell Bank, Cheshire

CANADIAN WATER POWER

According to the latest estimate of the Canadian Water Resources Division, Department of Northern Affairs and National Resources, Canada, the country's recorded water-power resources represent a feasible turbine installation of nearly 66 million h.p. The total turbine installation at the end of 1954 is given as 16,684,131 h.p., indicating that only about 25 per cent of available resources has been developed. During 1954 a record total of 1,758,450 h.p. of new capacity came into operation. The pulp-and-paper and the mineral industries are the most important consumers of hydraulic power. The installed capacity of water-power plants in Canada now equals 1,098 h.p. per thousand of population.

The province with the greatest water-power development is Quebec (7,773,822 h.p.), followed by Ontario (4,845,486 h.p.) and British Columbia (2,246,868 h.p.).

The total hydraulic power production is computed to be roughly the equivalent of the steam which could be produced by the burning of 35,300,000 tons of coal. This is approximately equal to the total consumption in Canada in 1954.

VILLAGE SUPPLIES IN CEYLON

A Rs300,000 electricity scheme promoted by the Kotte-Galkissa Village Committee has been formally handed over by the contracting firm of engineers. Kotte-Galkissa is a suburb of Colombo. Mr. D. L. Pathirage, chairman of the Committee, said that the area completed included ten miles of roads along which electricity would be available. He described it as one of the largest electricity schemes ever undertaken by a village committee.

A number of residents and businessmen of Agalawatte, 30 miles south of Colombo, have discussed the possibility of launching a private electricity scheme to supply the district. Plans drawn up by a firm of engineers have been considered and the Government Electrical Department is being asked to grant the necessary licence.

RADIO TELESCOPE

The modern science of radio-astronomy, which owes so much to Manchester University, should make great forward strides when the new radio telescope under construction at Jodrell Bank, in Cheshire, is completed. The two towers seen on the left and right of the accompanying picture will support the trunnions on which the aerial array will pivot. The telescope's aerial will have a diameter of 250ft and the towers will be 185ft high. The towers can move around a runway 310ft diameter on the ground, thus enabling every zone of the sky to be covered when required. The project is expected to cost about half a million pounds.

INDUSTRIAL NEWS

132 kV Oil-Filled Cable Contract

The Central Electricity Authority has recently placed with W. T. Henley's Telegraph Works Co., Ltd., on behalf of the North West, Merseyside and North Wales Division, the contract for supplying, laying, jointing and terminating 16,800 yd of 0·2 sq in 132 kV 3-core oil-filled cable. Where the cable is laid in ducts the conductor area will be increased to 0·25 sq in. The cable will form three feeders, each 5,600 yd long, between Agecroft switching station and Bloom Street substation, Manchester, and will be the first 3-core oil-filled cable in Great Britain to operate at 132 kV. The maximum design dielectric stress is 100 kV/cm. The link between the Agecroft power station and the switching station is by 1½ miles of 132 kV double-circuit steel tower line awarded to Henley's under a previous contract.

E.T.U. and Lyons' Electricians

Last week the Electrical Trades Union stated that a number of members employed by J. Lyons & Co., Ltd., had been fined £1 each and suspended from benefits for five years. These men returned to work in the face of the Union's instructions after a strike last year. The Union's statement claimed that a considerable number of the men concerned had expressed their thanks for the lenient treatment they had received and promised obedience to the rules in future.

On the other hand about sixty of the men have refused to pay the fines imposed and have threatened to break away from the Union. Their leader is Mr. M. Benson, who declined to pay a fine of £20 inflicted on him by the Union and was consequently expelled from his branch.

M.E.B. Furnace Exhibition

The next exhibition at the industrial showroom of the Sutton Coldfield and North East Birmingham District of the Midlands Electricity Board at 247, Chester Street, Aston, Birmingham, will be a display of induction melting furnaces, held in conjunction with Birlec, Ltd. It will be held from 6th to 18th June.

Portsmouth Technology and Science Week

A Technology and Science week commences on Monday next at the College of Technology, Portsmouth, the opening ceremony being performed by Sir Henry Tizard. It is being held to enable members of the public to know more about the opportunities for careers in industrial undertakings and its main objective is the recruitment of boys and girls for the various jobs open to them in Portsmouth and district. There will be a display of scientific and technical exhibits and films.

Plant for Manitoba

The Manitoba Hydro-Electric Board (Canada) has recently placed an order valued at over a million dollars with the Metropolitan-Vickers Electrical Co. The contract covers the third and fourth 33,000 kW single-cylinder turbo-generator sets for a new power station at Brandon, near Winnipeg. It brings the total capacity of generating plant ordered for this station to 132,000 kW, the first two units having been ordered from Metropolitan-Vickers in 1954. The turbo-generator sets for Brandon will run at 3,600 r.p.m. and will incorporate single-cylinder turbines designed for a maximum rated output of 33,000 kW, the largest output of any single-cylinder machines yet built by Metropolitan-Vickers; the initial steam conditions are 600 lb/sq in gauge and 825 deg F, exhausting to condenser at 28in Hg. The generators will be 13,800 V machines using hydrogen at a pressure of ½ lb/sq in for cooling.

Business Efficiency Exhibition

Over 117 firms will be participating in the 1955 Business Efficiency Exhibition, which opens at Olympia on 6th June. A total area in excess of 150,000 sq ft will include stands covering nearly 80,000 sq ft. The Duke of Edinburgh will visit the Exhibition on 7th June.

Commercial Travellers' Benevolent Institution

The Half-yearly Court of Governors of the Commercial Travellers' Benevolent Institution will be held at the Berners Hotel, Berners Street, London, W.1, on 18th June (12 noon), when all standing candidates will be recommended by the board for election.

Dutch Appliance Dealers' Visit

A party of twenty-five appliance dealers from Dutch cities, led by Mr. S. M. Zondervam, of Amsterdam, have recently made a brief visit to this country to see British-made appliances in production, during which they visited the new test kitchens at the English Electric Co.'s works at Liverpool. The demonstration included the use of automatic cookers and home laundry equipment.

Cast Iron Scrap Prices

The Minister of Supply has made the Iron and Steel Scrap (Amendment No. 1) Order, 1955, increasing the controlled prices of cast iron scrap in most areas. The increases are designed to encourage the movement of cast iron scrap between areas of surplus and areas of shortage and have been agreed with the British Iron and Steel Federation, the Joint Iron Council and the National Federation of Scrap Iron, Steel and Metal Merchants.

Prices of Materials

In the accompanying table we give the basis prices of the more important materials used in the electrical industry. The figures given are the selling prices and are those quoted on Tuesday last.

ALUMINIUM Ingots	ton £163 0s 0d
COPPER, H.C. Electro	ton £301 10s 0d
Fire Refined 99·70%	ton £300 0s 0d
Fire Refined 99·50%	ton £299 0s 0d
COPPER Tubes ..	lb 2s 11½d
Sheet	ton £370 5s 0d
H.C. wire and strip ..	ton £341 5s 0d
LEAD, English ..	ton £102 15s 0d
Foreign	ton £101 0s 0d
MERCURY	flask £108 0s 0d
TIN, block (English) ..	ton £714 10s 0d
ZINC, G.O.B. Foreign	ton £89 0s 0d
Electrolytic	ton —
BRASS Tubes (solid drawn)	lb 2s 4½d
Sheet	ton £298 5s 0d
Wire	lb 3s 0d
PHOSPHOR BRONZE Wire	lb 4s 5½d
PLATINUM	oz £29 0s 0d
RUBBER, No. 1 R.S.S. spot	lb 27⅛d—27¼d

Tendering Arrangements for Copper

The Board of Trade invites tenders for the sale of 15,000 tons of electrolytic copper for pricing and delivery over five months beginning in June. Applications for tender forms should be made to the Board of Trade (Room 3166), Horse Guards Avenue, Whitehall, London, S.W.1. This quantity forms part of the unsold balance (about 28,000 tons) of the 45,000 tons of electrolytic copper, the impending sale of which was announced by the Board of Trade on 13th April. The remaining 13,000 tons will be offered for sale later.

Small Gas Turbine

Following the successful development of a small 40/75 h.p. gas turbine unit in America by the Solar Aircraft Company, production is soon to start in this country at Crawley, in Sussex. A new company, Sugg Solar, Ltd., which was formed in March to undertake this work, gave a demonstration outside the Royal Festival Hall recently of one of these turbines in use driving a pump for fire fighting and driving a small generator.

As a power source the gas turbine has the advantage of a very high power

Simon hydraulic platform mounted on a lorry

to weight ratio. The "Mars" can be started by hand and when coupled to a pump and mounted in a convenient rig weighs only 175 lb, enabling it to be carried easily by two men, and making it remarkably portable for use in fire fighting. The gas turbine itself runs at 40,000 r.p.m., geared down to a pump speed of 4,500 r.p.m., and uses diesel oil, petrol or kerosene.

The low weight makes it useful for auxiliary power generation on aircraft and many such units have already been ordered for use in the U.S. Air Force. Outputs up to 8 kVA a.c. or 14 kW d.c. are so far available and the sets have passed all tests over a range of temperature from −65 deg F to +130 deg F and up to an altitude of 20,000ft.

Electric Steelmaking

A report on "Recent Advances in Steel Technology and Market Development, 1954," produced by the secretariat of the U.N. Economic Commission for Europe, has an introduction by Sir Charles Goodeve, director of the British Iron and Steel Research Association. In this Sir Charles expresses the opinion that during the next ten years the acid open-hearth furnace would be supplanted by the electric furnace, partly because of the development of nuclear energy in the form of electricity.

The report expects the annual production of steel in Western Europe to rise from the present figure of about 68 million metric tons to about 90 million tons in 1965.

Hydraulic Platform

The Simon engineering group gave an impressive demonstration of their new hydraulic platform last week at the Royal Festival Hall, London. This is shown in the accompanying photograph mounted on a lorry although it is capable of being mounted on any required base. Pressure is obtained by a pump driven by an internal combustion engine, all mounted integral with the rotating base. Movements are normally controlled from the platform itself by the operator, but duplicate controls are provided on the turntable. When mounted as shown the maximum platform height is 36ft and the maximum radius of operation from the turntable centre 23ft. Operation seemed simple and quite smooth. Among the uses to which the platform can be put are the maintenance of street lighting and overhead power and telephone systems, tree pruning, work on ships in dock and hangar repair work.

G. & J. Weir Diamond Jubilee

G. & J. Weir, Ltd., are making a bonus payment to all employees with more than three months' service of £5 plus £1 for each year of service to celebrate their diamond jubilee as a limited company.

Changes of Name

Technical Sales (Western), Ltd., has changed its name to Alliance Wires & Cables, Ltd.

Fischer Electronics Co., Ltd., has changed its name to Fisher Electronics Co., Ltd.

The Wolseley Sheep Shearing Co., Ltd., informs us that it has changed its name to Wolseley Engineering, Ltd.

Works Visit

Touring the works of Crompton Parkinson, Ltd., Chelmsford, recently, Rear Admiral Sir Philip Clarke, K.B.E., C.B., D.S.O., Director of the Naval Electrical Branch of the Admiralty, displayed keen interest in those departments concerned with the production of Admiralty equipment. In addition to meeting the administrative staff at Chelmsford he conversed with the works personnel, including many ex-naval men.

Powder Metallurgy Congress

The second international powder metallurgy congress, sponsored by Dr. Paul Schwarzkopf, president of the American Electro Metal Corporation, Yonkers, N.Y., will take place in Reutte, Tyrol, Austria, from 20th to 23rd June. The topic will be "High Temperature and Corrosion-Resistant Materials by Powder Metallurgy." The ferrous powder metallurgy interests of Metallwerk Plansee are represented in this country by George Cohen Sinteel, Ltd., a subsidiary of the 600 Group of Companies.

Cordless Telephone Exchange

Great Britain's first cordless telephone switchboard has been brought into use at the Thanet exchange at Margate. Operators press buttons and keys instead of plugging in. The chief supervisor has a control panel at which she can see the number of calls awaiting answer and the longest time a call has been waiting.

Metal Industry Handbook

The 1955 "Metal Industry Handbook and Directory" published for *Metal Industry* by the Louis Cassier Co., Ltd., Dorset House, Stamford Street, London, S.E.1 (472 pp.; 15s, postage 8d), is now available. Complimentary copies are being sent to all subscribers to *Metal Industry*.

The handbook is a comprehensive source of information for all those connected with the non-ferrous metal industries. Up-to-date information is given on the properties of the newer as well as the more familiar metals, and an extensive section is devoted to summaries of British Standard, Aircraft Material, D.T.D. and Admiralty specifications. The handbook also includes a section on the chief metal finishing processes and data regarding all the common rod, bar, sheet and strip products.

There is a useful directory for buyers and two new features have

Rear Admiral Sir Philip Clarke watching the construction of a large rotor at Crompton Parkinson's Chelmsford works. With him (left to right) are Mr. C. A. J. Martin, executive director and general sales manager, plant division (Crompton Parkinson), Mr. V. S. Cass, Machine Department production manager and Mr. A. V. Sowman, general manager, Chelmsford works (behind the operator)

been included in this year's edition:—Standard classifications of non-ferrous scrap and a list of trade names. The use of electricity in the production of non-ferrous metals and their electrical applications are dealt with in the appropriate sections.

Anglo-French Atomic Agreement

The United Kingdom Atomic Energy Authority and the French Atomic Energy Commision have recently concluded an agreement for the exchange of unclassified information between the two organizations on a range of subjects. The United Kingdom Atomic Energy Authority will furthermore help the French Atomic Energy Commission by giving advice and by supplying experimental quantities of various materials. The purpose of the agreement is to promote and develop the peaceful uses of atomic energy in the two countries in conformity with the movement for international co-operation in the field of atomic energy on a worldwide scale.

Electric Fence Fatality

The Bridgnorth (Shropshire) coroner held an inquest on 2nd May on Mrs. Betty Worden (36), wife of William Richmond Worden, an electrical engineer employed by A. T. & E. (Bridgnorth), Ltd., who received a fatal electric shock when she came into contact with an electric fence installed by her husband to keep their herd of goats under control.

Mr. Worden told the court that he wired his cottage at Eardington for lighting and power and after being duly passed by the Midlands Board it was connected. Following complaints by farmers about the goats wandering the Wordens decided that something effective must be done. Mr. Worden considered that an electric fence was the only deterrent likely to prove satisfactory. He said that he knew that stock-proof electric fencing in common use in Britain was battery energized, but having the mains available he preferred to make use of a mains supply. He constructed a circuit incorporating a transformer to step up the domestic pressure from 250 V to 500 V and using in series a resistor permitting the passage of a current not in excess of 1 mA. He considered that should a breakdown occur the surge of current would cause the resistor to disintegrate and break the circuit.

On the morning of the fatality he tested his fence and found it in order. The transformer, with the ¾in long resistor in the secondary circuit, was installed in the cottage near the switchboard. Answering the coroner, Mr. Worden said that he could not say what had gone wrong with the resistor but it had evidently failed without breaking circuit.

Midlands Electricity Board officers who gave evidence condemned the use of a transformer with exposed terminals standing on a stone floor. The resistor on test after the fatality showed a resistance of barely 7 ohms and was not of sufficient capacity to have afforded the protection Mr. Worden required. It had failed but they could not state the cause of failure. They also said that it was highly dangerous to use a mains source for a device of that kind; they would always favour fencing drawing its primary supply from a battery. The officials stated that on all the Board's account forms the public were clearly advised to consult it before installing fresh apparatus and to submit it for approval. Mr. Worden elicited that this was not compulsory where the installation did not form part of the normal circuit and said that he viewed connecting his fence to the supply (by plug and socket) as no different in principle from connecting a radio set or other such appliance. Therefore he did not think to seek approval. The coroner recorded death caused by electrocution by misadventure and absolved Mr. Worden from blame.

Industrial Safety Conference

Scarborough is again the venue for the National Industrial Safety Conference and trades exhibition of industrial safety appliances, which is organized annually by the Royal Society for the Prevention of Accidents. All meetings will be held in the Spa Theatre where on the evening of 20th May, after a welcoming speech from the Mayor of Scarborough, an opening address to the conference will be delivered by the chief inspector of factories, Sir George Barnett, who is chairman of the conference.

Five papers will be given and in a debate for which the motion is: "That this Conference agrees that a safety committee forms an essential part of an accident prevention organization," the speakers will include Mr. H. G. Frampton, deputy chief safety officer, Central Electricity Authority. The trades exhibition is being held in a hall adjoining the Spa Theatre.

B.B.C. and the E.T.U.

The B.B.C. has announced that under an agreement signed on 4th May the Corporation has recognized the Electrical Trades Union as a negotiating body, in addition to the B.B.C. Staff Association, on staff matters in respect of all categories of electricians and their assistants employed by the Corporation.

G.E.C. Canadian Acquisition

The General Electric Co., Ltd., of England, has just completed the purchase of 99 per cent of the shares of the Amalgamated Electric Corporation, Ltd., of Toronto. Mr. Leslie Gamage, vice-chairman and joint managing director of the G.E.C., played a large part in the negotiations for the purchase during the last fortnight of his recently concluded world business tour. He has stated that this association has for the G.E.C. the important long-term aspect of co-ordinating its business in Canada which has hitherto been conducted by the British General Electric Co. (Canadian), Ltd., formed in 1949. It meets the need to supplement exports to Canada with facilities for local assembly or manufacture of equipment to Canadian requirements.

Although its Canadian business will be channelled through the Amalgamated Electric Corporation, the latter will remain essentially Canadian in character and under the existing Canadian management. Mr. A. V. Armstrong will continue to lead its team of executives. Mr. Leslie Gamage, Mr. D. G. W. Acworth, manager of the Export Department of the G.E.C., and Mr. J. B. Taylor, managing director of the British General Electric Co. (Canadian), Ltd., are to join the board.

The Amalgamated Electric Corporation, Ltd., was formed in the 1880s and played an important part in the early history of Canada's electrical industry. It has a factory in Toronto of over 200,000 sq ft, with a smaller plant in Winnipeg. Sales branches are established in Toronto, Montreal, Winnipeg, Calgary and Vancouver. Its products include electrical distribution and lighting equipment, motor control apparatus and wiring supplies.

Lifts for Bucklersbury House

At a cost of over £200,000, the fastest bank of lifts in London are to be installed by the Express Lift Co., Ltd., in Bucklersbury House, over the original site of the buried Roman temple of Mithras, God of Light. Travelling at a rate of 700ft a minute, passengers will be conveyed to the thirteenth (top) floor in 12 seconds. There will, however, be little sensation of speed, for the lifts, of which there will be seventeen arranged in three banks, will be of the smooth running gearless variable voltage type. It is anticipated that work on the building will be completed by the middle of 1957.

Electrical Commercial Travellers

We are informed that the recently formed North Western branch (Manchester) of the Electrical Trades' Commercial Travellers' Association already has a membership of 115, but it hopes to enrol many more commercial travellers in its area. The chairman of the branch is Mr. R. H. Corlett (Hardman & Co., Ltd., Rochdale) and the secretary, Mr. W. Smith (Ega Electric, Ltd.).

Zinc Development Association

The Zinc Development Association and its affiliates, the Hot Dip Galvanizers', the Zinc Alloy Die Casters' and the Zinc Pigment Development Associations, have removed from Oxford to 34, Berkeley Square, London, W.1 (telephone: Grosvenor 6636). Among the features of the new premises will be a permanent

The new G.E.C. premises at Gloucester and (right) the Mayor performing the opening ceremony. With him is Mr. Leslie Gamage, vice-chairman and joint managing director

exhibition of zinc and zinc products, on which a further announcement will be made as soon as the necessary alterations and decorating have been completed and the exhibition is open to the public.

New G.E.C. Gloucester Premises

The Mayor of Gloucester, Councillor Howard A. Gibson, recently opened the new branch premises of the General Electric Co., Ltd., in Great Western Road, Gloucester. The opening ceremony was attended by Mr. Leslie Gamage, vice-chairman and joint managing director, and many friends of the G.E.C. in the area.

The new building provides 18,000 sq ft of office, store, service and showroom space. The majority of accommodation is on two floors, the ground floor being devoted to modern showrooms, stockrooms, the trade counter, receiving and despatch departments, and the first floor to offices and further stockrooms. A smaller third floor is devoted to stores and a staff room. The showrooms are well furnished in the contemporary style. The building is heated by a 200 kW electrode boiler.

The designs for the new premises were prepared by the company's constructional engineer's department, Wembley. Local contractors and local materials were employed in their construction, the main contractors being W. J. B. Halls, Ltd., and the electrical contractors John Hearson & Co., Ltd. The manager of the branch is Mr. I. R. Morgan.

International Radio Marine Conference

The sixteenth conference of the Radio Marine Associated Companies (R.A.M.A.C.) opens at the Imperial Hotel, Torquay, on Monday next. Delegates representing marine radio operating companies from many different countries will attend. It is the custom for each of the twenty-four member companies to act in turn as host to the conferences. On this occasion the host company will be Amalgamated Wireless (Australasia), Ltd., but since travelling to Australia would be impracticable for most delegates the conference is to be held at Torquay and Mr. L. A. Hooke, managing director of Amalgamated Wireless (Australasia), Ltd., is coming to Britain to welcome the delegates who will attend. Mr. H. C. Van de Velde, deputy to the managing director of the Marconi International Marine Communication Co., Ltd., is chairman of R.A.M.A.C. and will preside at the conference. Mr. E. Fost is secretary-general.

Trade Announcements

The **Sloan Electrical Co., Ltd.,** 31-33, Broadway, London, S.W.8, is now to incorporate radio and television suppressors as a standard fitting in its "Summit" vacuum cleaners. The cylinder model is now fitted as standard with three-core flex.

Mr. M. A. Graham has been appointed sole technical representative in Northern Ireland for **Rhodes, Brydon & Youatt, Ltd.** His address is 10, Brunswick Street, Belfast (telephone: Belfast 29087).

Mr. J. Sime has been appointed representative in Scotland for the **Jackson Electric Stove Co., Ltd.** He will be attached to the Glasgow branch office.

Electro-Mechanical Supplies (Leicester), Ltd., have appointed Mr. W. Robson, 76, The Grove, Trowell, Notts, district representative for the Nottingham area.

Siemens Electric Lamps & Supplies, Ltd., has opened a new sub-stores at 36, Wind Street, Swansea, under the area managership of Mr. W. A. Cooper. The telephone number of the stores is Swansea 50214.

Donald MacPherson & Co., Ltd., have opened a depot at 22, Saxton Lane, Leeds, 9 (telephone: 23856). Mr. H. Boyce is in charge of the new depot.

From Monday next the address of **Henry Turner & Co.** will be 58, Upper Tooting Road, London, S.W.17.

Mr. P. L. Webb has been appointed London branch manager of **Permanoid, Ltd.,** and will be responsible for sales in London and the Home Counties. He was formerly with the Telegraph Construction & Maintenance Co., Ltd. Mr. D. Underwood has also joined Permanoid as area representative for East London and the eastern counties. Mr. E. E. Murless will continue to represent the company in the West and North London areas.

Mr. Ken Wood, managing director of **Kenwood Electrics, Ltd.,** opened his company's first service centre outside London on 25th April in Candleriggs, Glasgow. The new service centre will be operated in conjunction with S. W. Cohen, Ltd., distributors of Kenwood products in Scotland.

On Monday next **W. T. Henley's Telegraph Works Co., Ltd.,** will open a new stores depot at Craven Street, Leicester (telephone: Leicester 23653). The store will be under the control of Mr. F. Bull, Henley's Nottingham branch manager, and Mr. B. H. Sprake will be the local representative.

CATALOGUES & LISTS

ACCESSORIES.—Price adjustment booklet (H.C.P.369) for use with the company's 1955 catalogue of electrical accessories.—**M.K. Electric, Ltd.,** Wakefield Street, London, N.18.

BUSBAR TRUNKING.—Illustrated 26-page priced catalogue of overhead busbar trunking in capacities from 175 to 600 A.—**Ottermill Switchgear, Ltd.,** 1, Victoria Street, London, S.W.1.

CABLES.—Four-page folder dealing with a range of heat resisting asbestos cables and flexibles.—**Saxonia Electrical Wire Co., Ltd.,** Roan Works, Greenwich, London. S.E.10.

112-page thumb-indexed catalogue (E.N. 103) covering rubber and thermoplastic insulated cables.—**Enfield Cables, Ltd.,** Victoria House, London, W.C.1.

Technical catalogue giving particulars of a range of telecommunication and control cables and four leaflets describing aluminium cored cables, p.v.c. flexibles and cables, and other products of the company.—**Sterling Cable Co., Ltd.,** Aldermaston, Berks.

TRANSFORMERS.—Illustrated descriptive catalogue of 20 pages dealing with the company's range of power and distribution transformers.—**Transformers & Electrical Co., Ltd.,** Eastern Works, Eastern Road, London, E.17.

PARLIAMENTARY REPORT

Electronic Engineers

In the House of Commons Mr. Osborne asked the Minister of Labour if he was aware that American companies were offering salaries of £3,500 per annum, plus facilities for fishing and sailing and modern domestic accommodation and travelling allowances, to young electronic engineers, whose pay in British industry averaged £1,400 per annum; and if he would exempt from National Service men who were training to become electronic engineers.

Mr. Harold Watkinson, in reply, said he was aware that vacancies in the United States for electronic engineers had been advertised in this country. He was not clear what bearing this had on the second part of the question, but deferment was already given to men taking approved courses of study leading to a recognized professional qualification in engineering, including electronic engineering.

Television Sets

Dr. Hill, Postmaster-General, informed Mr. Crouch that there were 958,333 television licences in force on 1st October, 1951, and 4,503,766 on 31st March, 1955.

Telegraph Poles

Mr. Crouch asked what was the cost of steel and wood telegraph poles, respectively; and what was the number of each used in 1954.

Dr. Hill said that the Post Office had not bought any steel poles since 1949; they then cost from two to three times as much as wooden poles, depending on size. Last year it used 6,300 of its remaining stock of steel poles, and 127,800 wooden poles.

New Telephones

Dr. Hill told Wing Commander Bullus that 1,300,000 subscribers' lines had been connected since October, 1951.

Street Lighting Administration

Mr. Page asked the Minister of Transport whether, in view of the report of the Road Research Board that better street lighting could reduce accidents at night by 30 per cent and that surface dressing of roads could eliminate skidding accidents, he would take steps to intensify these two types of road improvement.

Mr. Boyd-Carpenter said it was his policy to encourage improvements of this kind. He had the whole question of the administration of street lighting under consideration.

Farm Supplies in Norfolk

In answer to Sir Frank Medlicott, the Minister of Agriculture, Mr. Heathcoat Amory, said that in the Eastern Electricity Board's Norfolk Sub-Area the numbers of farms first provided with electricity during each of the five years 1951 to 1955 were 283, 158, 144, 292 and 397, a total of 1,274.

Clean Air Bill

Mr. Marquand asked the Minister of Housing and Local Government whether he had completed his consultations with persons and organizations interested in the Clean Air Bill.

Mr. Sandys replied that the initial round of consultations was now nearly completed. He hoped that, early next session, he might be in a position to make a further statement.

Trade with Roumania

Mr. Low, Minister of State, Board of Trade, informed Mr. Osborne that the negotiations with the Roumanian trade delegation which had been in London for the past few weeks covered both finance and trade. They were rather difficult negotiations and he would prefer to wait until they were completed before making a statement on them.

Television in Cumberland

The Postmaster-General (Dr. Hill) told Mr. Hargreaves that the B.B.C. had not yet chosen a site for the radio and television station proposed to serve Carlisle. Tests were being carried out on possible sites for the television station, which it was hoped to open by the end of next year. The Corporation contemplated that a v.h.f. sound broadcasting station would eventually operate from the same site.

Industry in Ulster

In a statement about the industrial developments which were taking place in Northern Ireland, the Home Secretary, Major Lloyd-George, referred to the British Thomson-Houston's large new factory at Larne for the manufacture of electrical equipment, much of it intended for export.

STREET LIGHTING NOTES

The annual report of the Durham County Association of Parish Councils states that it is quite beyond the financial resources of small parish councils to light sections of the Great North Road in their areas, even with the assistance of Government grants. In the case of one parish council which has had to abandon a scheme for lighting part of the road between Chester-le-Street and Framwellgate Moor the net product of a penny rate is only £24 while it costs £40 to erect a lighting unit to the Ministry's specification and £10 annually for lighting and maintenance. The report says that the Ministry of Transport should be responsible for lighting the road.

CIRENCESTER U.D.C. plans to modernize the street lighting at a cost of £7,200.

COVENTRY Road Safety Committee has approved schemes, estimated to cost £19,710, for improved street lighting in 1955-56.

EPPING U.D.C. has approved the preparation of a new scheme for the lighting of the town.

Two additional miles of Group "A" sodium street lighting has been installed at GOSPORT, Hants, between Brockhurst Corner and the Gosport and Fareham boundary. This is the latest section completed in a major programme to relight the streets throughout the town. Some 100 "Mazda" enclosed-type lanterns with 140 W sodium lamps are mounted on Stewarts & Lloyds columns. The contractors were the Southern Electricity Board.

By next March the number of gas lamps in HORBURY will have been reduced to 166. The Council has allocated £2,877 for street lighting conversion this year.

RICHMOND (Yorks) Corporation is applying for permission to borrow £8,090 for sodium street lighting.

RUNCORN R.D.C. has authorized the preparation of a scheme for the conversion of street lamps in Stockton Heath, Grappenhall and Appleton from gas to electricity.

SCARBOROUGH Streets Committee is seeking sanction to borrow a further £24,000 for the conversion of street lighting from gas to electricity. Fluorescent lamps are to be installed in the main streets.

STOCKTON-ON-TEES Town Council is seeking loan sanction for £12,420 for sodium lighting in Haverton Hill Road.

WARRINGTON Corporation is to make application for consent to borrow £11,000 for street lighting conversion from gas to electricity.

Improved lighting in WATFORD, except along the Watford by-pass, is estimated to cost £34,306.

INDUSTRY AND THE HOUSE

End-of-Parliament Thoughts

By A. M. F. PALMER, A.M.I.E.E.

THE present Parliament will have ended by the time this article appears in print, but it ceased to live before its final day. From the very hour the Prime Minister announced that a new Parliament would be elected on 26th May, the faithful Commons became but ghosts of their former selves.

At question time on the final days there was still plenty of noise, but this was more a preliminary for the hustings rather than the penetrating cross-fire that once we knew. Hence it is appropriate, in my last article about a Parliament now dead, to mention briefly how industry, science and technology fared in its lifetime.

A general comment is that both Houses of Parliament in the last few years have given more time to industrial, economic and scientific topics than perhaps ever before in history. Engineers and technologists, unfortunately, are not strong in numbers among the membership of the Commons; compared with lawyers, schoolmasters and schoolmistresses, university dons and even medical men, they are a poorly represented profession. (Is it that the accurate technical mind does not take too easily to the intangibles, abstractions and the attitudes inseparable from the conduct of public affairs?) Yet such are the mental resources of honourable Members that there are few discussions which do not produce their quota of apparently knowledgeable "experts" and the needs of the time encourage this. As was said in the first 1952 article in this series: "Parliamentary life appears to be settling to a new norm more suitable to the realities of the 1950s. Confident assumptions about the future in one camp, nostalgic yearnings for the past in the other, seem to have given way to a common concentration—implied if not admitted—on the immediate present."

In the same article there was noted one intriguing short paragraph in the Queen's Speech which received scant attention from the general run of speakers in the debate on the Address. It was a reference to the intention of the Government "to examine attentively" the supply of electricity in Scotland. From thoughts to deeds: a recent issue of the *Electrical Review* gave an account of the responsibilities of the new South of Scotland Electricity Board; free to go its own way from 1st April of this year. A surprise by-product of the change not foreseen was the demotion of the British Electricity Authority to that of a mere "Central" Electricity Authority.

Policy on Electricity Supply

It must be conceded that in electricity supply affairs the Conservatives have acted with considerable adroitness. They have been careful not to alarm and disturb by opposing a counter-revolution to the revolution of Vesting Day. But where, without running the risk of being accused of attacking the principle, they can chip the edge of nationalization, they have done so. And if a new Conservative Ministry results from the General Election on 26th May, it may well be that the Herbert Committee, still in the midst of its investigations, will be seen in the end as something more than a reviewing and fact-finding body. Was it a mere drafters' whim that the Herbert Committee received mention among the listed achievements of the Government in the Conservative manifesto? A new Conservative Government might, conceivably, use the Herbert Report—rather as Labour used the McGowan Report in the debates on the Electricity Act, 1947—as justification for continuing processes now initiated by the passing of the Scottish Act.

Steel and Road Haulage

In Labour's manifesto it is stated (in heavy type): "Public ownership of the steel and the road haulage industries is essential to the nation's needs and we shall re-nationalize them." Some of the early articles in this series dealt with the long and at times wearisome discussions on the measures to *de-nationalize* transport and iron and steel. It was noted then that a novel feature of the Conservatives' compromise iron and steel proposals was the bringing into the span of control of the proposed supervisory board all kinds of ancillary firms untouched by the nationalization Act. It was also recorded that Labour had been quick to hint that this would be a possible precedent to be remembered on re-nationalization. Would a new Labour Government follow through with this line or return its nationalization to the boundaries set by the first Act?

When once able to forget the political emotions aroused by the word "nationalization," the House on both sides has been generous and quick to recognize the considerable technical achievements of the Boards. There have been some excellent, if quiet debates on the annual reports of the coal, electricity and gas industries; detailed attention has been given to the problem of safety in the mines; Members from rural constituencies have vied with each other in discussing rural electrification problems.

Atomic Power Programme

The most novel and adventurous industrial proposal brought before the last Parliament was undoubtedly the nuclear energy programme. The world's finest scientific brains, combined with imaginative public supervision, have given the United Kingdom a deserved lead over both the United States and Russia in the peaceful application of nuclear processes. But Members, while quick to praise the programme, have as yet hardly taken it seriously.

The House as a whole does not thoroughly understand how real and urgent is Britain's modern fuel crisis. If this were understood Members might have asked the responsible Ministers if the programme was anything like big enough. They might also have induced the policy drafters of both Parties to have found a line or so for the matter in their election manifestos. It is not reasonable to speak of higher standards being founded on increased productivity without proposing to do something practical about a paucity of the energy supplies from which in the end that productivity derives.

Whoever wins it is safe to predict that the new Parliament will talk as much, if not more, than its predecessor on industrial, scientific and technical matters. These things have a way of intruding themselves whether invited or uninvited.

West Germany's Electrical Exports

Further Big Increase in 1954

EXPORTS of electro-technical products, including machinery, from Western Germany last year totalled DM.1,670 million in value, an increase of about one quarter on the previous year. While distribution ranged over practically all world markets for electrical goods, Europe was the predominant buyer, the Netherlands taking approximately one-tenth of the total, with Sweden coming next (DM.132 million against DM.98 million in 1953), Italy and Belgium-Luxemburg each over DM.100 million, and Switzerland DM.85 million (DM.65 million in 1953). Outside Europe, important outlets were Argentina, Brazil, Venezuela, the United States, Colombia, Uruguay, Egypt, India, Iran, Pakistan and Australia. The total for the U.S.S.R. was DM.37 million (DM.4 million in 1953) mainly insulated wire and flex.

The accompanying statement gives the values of the principal groups and some of the more important destinations in 1954 with notes of increases or decreases on 1953. Outstanding among the former were radio goods, electrical equipment for vehicles, and cable and wire.

Class of Goods	1954 DM. (000)	Inc. or dec. on 1953 DM. (000)
Generators and motors up to 10 kW	40,714	+ 10,431
To Belgium	3,072	+ 812
,, Netherlands	6,252	+ 1,705
,, Norway	3,120	+ 949
,, Sweden	6,731	+ 2,081
,, Switzerland	2,940	+ 675
,, France	1,797	+ 185
,, Denmark	1,070	+ 406
Ditto 10 to 1,000 kW	40,530	− 6,920
To Belgium	1,888	− 1,347
,, Luxemburg	1,239	+ 551
,, Italy	1,319	+ 97
,, Yugoslavia	2,153	+ 428
,, Netherlands	4,061	+ 543
,, Norway	1,931	− 1,021
,, Sweden	2,400	− 2,126
,, Iran	2,059	+ 1,078
,, India	2,615	+ 1,046
,, Pakistan	1,109	− 1,132
,, Brazil	5,304	+ 1,658
Over 1,000 kW	30,088	+ 838
To Finland	6,437	+ 5,209
,, France	3,034	+ 3,000
,, Eire	1,873	+ 1,800
,, Switzerland	2,797	+ 895
,, Turkey	1,589	− 3,751
,, Indonesia	1,361	+ 1,300
,, Pakistan	1,633	+ 1,600
,, Brazil	2,496	+ 1,542
Generating sets	93,628	− 22,188
To Denmark	3,674	+ 1,594
,, France	4,961	+ 4,106
,, Italy	6,076	− 8,779
,, Yugoslavia	3,145	+ 318
,, Netherlands	5,911	+ 4,832
,, Turkey	2,791	+ 84
,, Saudi-Arabia	2,438	+ 1,959
,, Burma	2,152	+ 860
,, Indonesia	3,416	− 2,443
,, Iran	3,592	+ 3,113
,, Pakistan	3,166	− 2,493
,, Argentina	3,578	− 7,287
,, Brazil	22,285	− 6,370
,, Australia	3,904	+ 2,796
Transformers and chokes	53,665	+ 5,982
To Finland	2,751	− 1,988
,, Greece	2,356	+ 558
,, Sweden	4,033	− 3,014
,, Eire	1,220	− 830
,, Turkey	3,904	+ 369
,, India	4,023	+ 1,083
,, Yugoslavia	2,939	+ 592
,, Netherlands	3,366	+ 569
,, Uruguay	5,671	+ 4,738
,, France	2,061	+ 1,106
Current regulators	13,050	− 3,246
To France	1,859	+ 880
,, Netherlands	1,072	+ 352
,, Norway	1,178	− 4,947
,, Italy	990	+ 258
,, Switzerland	914	+ 292
Electric tools	27,293	+ 6,128
To Belgium	2,019	+ 318
,, Denmark	1,539	+ 295
,, France	1,349	+ 247
,, Italy	3,621	+ 1,569
,, Netherlands	3,036	+ 958
,, Austria	2,331	+ 873
,, Sweden	1,811	+ 777
,, Switzerland	2,728	+ 548
Primary cells and batteries	9,011	+ 1,637
To Turkey	3,164	+ 36
,, Sweden	978	+ 427
,, Denmark	956	+ 506
Accumulators and parts	21,530	+ 5,521
To Turkey	3,884	+ 1,486
,, Egypt	1,360	− 200
,, Iran	1,791	+ 846
Vacuum cleaners and floor polishers, household	17,211	+ 5,424
To Belgium	1,905	− 142
,, Italy	2,346	+ 469
,, Netherlands	1,905	+ 602
,, Norway	1,329	+ 516
,, Austria	2,534	+ 2,034
,, Sweden	1,371	+ 949
Washing, drying and wringing machines, household	35,810	+ 9,534
To Belgium	4,179	+ 494
,, Netherlands	8,815	+ 1,954
,, Norway	7,321	+ 3,180
,, Austria	5,418	+ 4,115
,, Switzerland	3,327	+ 870
Fans up to 600 W	3,306	+ 1,397
To Greece	276	+ 188
,, Iraq	283	+ 280
,, Iran	208	+ 100
Other household appliances up to 15 kg	6,239	+ 1,044
To Belgium	1,351	+ 329
,, Austria	1,489	+ 945
,, Sweden	702	− 57
Shavers and hair dryers	9,580	+ 4,026
To U.S.A.	3,127	+ 3,100
,, Netherlands	1,090	+ 185
,, U.K.	883	+ 589
,, Sweden	639	− 19
Signalling and safety apparatus	6,447	+ 1,201
To Saar	836	+ 133
,, Belgium	714	+ 367
,, Netherlands	787	+ 164
Elec. equipment, n.e.i., for cycles, motor cycles, motor vehicles, aircraft, ships or other vehicles	68,858	+ 22,397
To Belgium	4,353	+ 1,224
,, Denmark	4,920	+ 2,025
,, Italy	2,535	+ 859
,, Netherlands	7,982	+ 2,683
,, Norway	2,580	+ 811
,, Austria	3,353	+ 1,754
,, Sweden	14,567	+ 3,329
,, Switzerland	2,157	+ 175
,, Malaya	2,800	+ 2,114
,, Australia	8,756	+ 3,529
Welding apparatus	19,989	+ 6,988
To France	1,702	+ 697
,, Netherlands	1,266	+ 362
,, Austria	1,292	+ 1,050
,, U.S.A.	2,652	+ 2,314
Electric ovens, industrial and household	31,972	+ 8,152
To Italy	2,211	+ 218
,, Yugoslavia	2,592	+ 2,500
,, Switzerland	3,730	− 257
,, Austria	2,976	+ 2,330
,, Greece	2,085	+ 810
,, Belgium	1,940	+ 1,010
Pressing irons	8,998	+ 3,024
To Belgium	827	+ 325
,, Netherlands	835	+ 280
,, Colombia	1,006	+ 575
Other heating appliances and parts	25,155	+ 9,002
To Belgium	2,284	+ 893
,, Italy	2,051	+ 556
,, Netherlands	2,583	+ 1,214
,, Austria	2,174	+ 1,493
,, Sweden	2,456	+ 1,069
,, Switzerland	2,596	+ 852
Radiological apparatus and accessories	40,228	+ 163
To Netherlands	2,905	+ 1,189
,, Italy	2,263	+ 753
,, Sweden	2,229	+ 668
,, Finland	1,702	+ 966
,, China	164	− 3,030
,, Hongkong	241	− 6,172
,, Argentina	1,911	− 1,575
,, Brazil	3,504	− 135
Electro-medical, surgical and dental apparatus	16,184	+ 382
To Italy	1,130	+ 12
,, Netherlands	1,549	+ 429
,, Sweden	1,265	+ 48
,, Switzerland	1,444	+ 333
,, Hongkong	64	− 1,857
Telephonic apparatus	60,772	+ 4,556
To Saar	2,678	− 531
,, Finland	5,294	+ 2,956
,, Greece	2,796	+ 1,763
,, Italy	10,734	− 3,831
,, Venezuela	10,870	+ 9,273
,, Pakistan	2,084	− 257
Telegraphic apparatus	17,175	+ 1,710
To Netherlands	1,903	+ 326
,, Norway	1,671	+ 108
,, Switzerland	1,417	+ 256
,, Argentina	1,206	+ 247
Radio apparatus	178,606	+ 64,431
To Belgium	18,749	+ 6,209
,, Italy	14,665	+ 7,812
,, Netherlands	35,622	+ 17,909
,, Switzerland	23,234	+ 6,930
,, Sweden	6,321	+ 4,075
,, Greece	5,276	+ 2,734
,, U.S.A.	5,190	+ 4,147
,, Colombia	4,362	+ 1,367
,, Egypt	3,633	− 1,266
Elec. condensers	14,312	+ 6,004
To Netherlands	2,727	+ 882
,, Sweden	1,190	+ 589
,, Brazil	1,233	+ 767
Switchgear	87,582	+ 13,326
To Finland	3,115	+ 1,621
,, France	5,885	+ 4,239
,, Italy	4,641	+ 601
,, Yugoslavia	6,584	− 5,105
,, Netherlands	6,136	− 1,374
,, Austria	4,103	+ 879
,, Egypt	4,168	+ 2,670
,, Brazil	4,059	+ 2,303
,, Uruguay	3,782	+ 1,993
Cable	91,746	+ 22,767
To Venezuela	11,598	+ 8,181
,, Egypt	6,347	+ 1,855
,, Israel	4,950	+ 3,788
,, India	4,331	+ 990
,, Uruguay	3,436	+ 386
Insulated wire, flex, etc.	87,146	+ 44,185
To U.S.S.R.	34,430	+ 31,349
,, Venezuela	4,374	+ 798
,, Colombia	3,235	+ 578
,, Greece	3,018	+ 1,886
,, Netherlands	2,901	+ 1,351
Elec. lamp bulbs and tubes	23,683	+ 7,546
Thermionic or electronic tubes and valves, not used for lighting	20,474	+ 7,895
To U.K.	4,741	+ 3,401
,, Netherlands	5,606	+ 3,216
,, Italy	2,185	+ 173
Installation apparatus up to 750 V	51,470	+ 14,797
To Netherlands	11,142	+ 3,579

Railway Modernization

DETAILS OF FIRST INSTALMENT ANNOUNCED

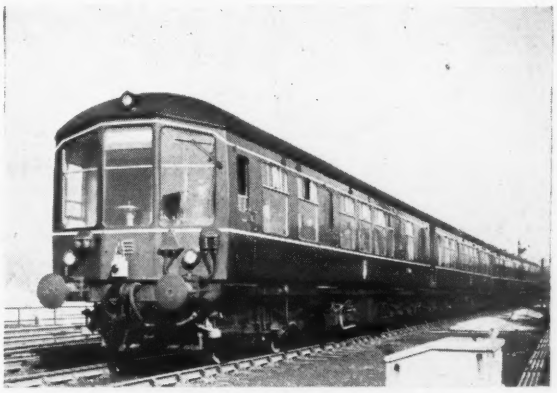
CONTRACTS for rolling stock valued at £35 million have already been placed with British manufacturers under the railway modernization and re-equipment plan which is to be carried out over a period of fifteen years at a total cost of £1,200 million. This was announced by the British Transport Commission at a Press conference last week when an indication was given of the main projects of improvement expected to begin this year and next.

One of the biggest items in the 1955-56 programme is the provision of 1,000 vehicles for the further replacement of steam passenger services by multiple-unit diesel trains. The contracts so far placed include 844 of these vehicles to be supplied by the Birmingham Railway Carriage & Wagon Co., Ltd. (393), the Metropolitan-Cammell Carriage & Wagon Co., Ltd. (339), Cravens, Ltd. (72), and the Gloucester Railway Carriage & Wagon Co., Ltd. (40). An order has also been placed with the General Electric Co., Ltd., for electrical equipment for 57 three-car sets for the renewal of electric rolling stock for the Euston-Watford line.

Over the fifteen-year period some 2,500 main line diesel locomotives are to be built and an important part of the programme for 1955-56 is a pilot scheme under which extensive trials are to be carried out before final decisions are made on those required for bulk delivery. At present several types are in use on British Railways and to some extent they are of experimental design. For the pilot scheme the Commission has approved the introduction of 171 new diesel locomotives for main line service. Forty of these will be of Type A (600-800 h.p.), a hundred of Type B (1,000-1,250 h.p.) and thirty-one of Type C (2,000 h.p. or over). All these will be diesel-electric except eleven locomotives of Type C which will be diesel-hydraulic. The specifications provide for up to three locomotives of Types A and B to be worked together as a multiple unit if required, and two of Type C. Eventually all steam shunting locomotives are to be replaced by diesels; at present there are over 300 diesel shunters in service and it is expected that another 150 will be added this year with a further 200 next year.

By the end of 1956 the extension of the electrification of the Liverpool Street-Shenfield line to Chelmsford and Southend (Victoria) is expected to be completed at a cost of £2·5 million, and this will form the basis of further electrification along the Eastern Region main line to Ipswich, Clacton, etc. Work on the associated scheme from Fenchurch Street to Tilbury and Southend is not so far advanced. Extensive preliminary engineering works are involved before a start can be made with the actual electrification. Perhaps the most important of these preliminary works are the reconstruction of Barking Station, the rearrangement of the running lines in the neighbourhood with the provision of "flyover" junctions, and new freight facilities. The scheme for the Barking "flyover" and the rearrangement of the track layout are estimated to cost £1·5 million, and a start will be made in 1956.

Preliminary planning work is being put in hand in the



Right: A multiple-unit train now in use on the Bradford–Leeds–Harrogate services. Below (left): Co-Co electric locomotive hauling an express passenger train on the recently electrified Manchester–Sheffield line. The 2,000 h.p. diesel-electric locomotive on the right is at present in experimental service hauling express passenger trains between London and the West Country

Eastern Region on the suburban electrification from Liverpool Street to Enfield and Chingford, Hertford and Bishop's Stortford, and also on the scheme for the former Great Northern section. Preliminary work should also start on the extension of the Southern Region electrification over the remaining steam-operated main lines in Kent. In the London Midland Region, first steps will be taken towards the preparation of the main line electrification scheme from Euston to Birmingham, Liverpool and Manchester.

Track and signalling programmes being introduced will provide for the improvement or strengthening of the track at various places in order to prepare for higher speeds and better punctuality; meanwhile the authorized renewal programmes, including the complete renewal of 1,800 track miles this year, will cover ordinary maintenance requirements. In the Eastern Region the provision of four tracks between New Barnet and Potters Bar—a pre-requisite of the electrification of this line—is expected to start this year. The work involves the construction of three new tunnels at a cost of nearly £2·75 million.

Additional schemes for the introduction of colour-light signalling, and the concentration of signal boxes, will be put in hand in the next two years at a number of places, costing over £600,000. Other signalling developments which may be introduced in this period will cost over £500,000. Improvements in telecommunications at various places will cost £325,000.

An important station improvement scheme which is being considered and may be put in hand during the next two years is a new track layout, coupled with the installation of modern colour-light signalling and greatly improved accommodation for passengers, at Manchester (Victoria). A number of other station reconstruction or improvement schemes are in an advanced state of development and will start in the next two years, including that for Cannon Street Station (replacement of roof and lengthening of platforms, to cost £1,280,000). Major schemes are planned for eight marshalling yards and eight goods stations.

Mr. A. S. Quartermaine, who retired from the position of chief engineer, Western Region, British Railways, in 1951, has accepted an invitation from the Commission to undertake special duties in connection with the recruitment and training of technical staff for the modernization plan. Mr. E. J. Larkin, assistant mechanical and electrical engineer, London Midland Region, Derby, has been appointed with Mr. Quartermaine to deal specifically with the requirements of the Mechanical and Electrical Engineering Departments. Their task, in conjunction with the general managers of the Regions, will be to promote recruitment from the universities, technical colleges, public, grammar and secondary schools, appointments bureaux, and from among experienced engineers. They will also make recommendations on the methods of training and the expansion of training facilities.

Mr. J. H. Brebner, the Commission's public relations officer, pointed out that the programme as far as 1956 was concerned must be regarded as tentative and would be amended and enlarged as circumstances permitted. Questions on the plans were answered by Mr. J. Ratter, technical adviser to the Commission, and Mr. M. Bonavia, chief officer, new works. It was stated that the diesel tests would be carried out in at least three Regions. No more steam express passenger locomotives were being built. Although it was proposed to electrify the remaining lines in South East England there would be an exception in the case of the Hastings main line on which six-car diesel-electric multiple unit trains would be used.

Nuclear Power Corporation

PLANS for the establishment of a new Corporation which will concentrate on the design and construction of complete nuclear power plants are announced by Sir Claude Gibb, chairman and managing director of C. A. Parsons & Co., Ltd., in his statement circulated with the company's annual report and accounts, an abstract of which is given in the Financial Section of this issue.

Sir Claude refers to the major part which the company and its associates have played in the peaceful application of power from nuclear energy. The Parolle Electric Plant Co., Ltd., which is owned jointly with A. Reyrolle & Co., Ltd., has, with the C. A. Parsons and Reyrolle research staff, been associated since 1948, first with the Atomic Energy Division of the Ministry of Supply, and since its formation, with the United Kingdom Atomic Energy Authority, in a feasibility study of the industrial application of atomic energy. Parolle engineers have collaborated with the engineers and scientists of the Industrial Group of the A.E.A. in the design of the plant for the Calder Hall project and the solution of the many problems which the project involves. Resulting from this collaboration orders were received and production is now well advanced for the special dual pressure turbo-generators and associated equipment as well as the gas circulators and cooling gas ductwork.

In order to be ready to participate in the extension of nuclear power forecast in the Government White Paper, the directors of C. A. Parsons have taken the initiative with a number of companies to form a separate Corporation which will concentrate on the design and construction of nuclear power plants in any part of the world.

During 1954 a long-term agreement for future collaboration was made between C. A. Parsons and Head Wrightson & Co., Ltd., who have outstanding design and manufacturing experience in heat transfer equipment and in chemical engineering, and have gained much valuable experience in the design and construction of experimental nuclear reactors. This agreement has now been extended to include other specialist companies, and the new Corporation, with an authorized capital of £1,000,000, is in the process of formation.

Bending of Turbine Shafts

EXPERIMENTS carried out on two carbon-molybdenum turbine shafts of different nickel content to ascertain the cause of reversible bending were described in a paper presented on 6th May by Mr. A. Barker and Dr. F. W. Jones (Brown-Firth Research Laboratories) before the Institution of Mechanical Engineers. The bending was shown to be due to a difference in expansion coefficient in the steel on opposite sides of the shafts which was a result of non-uniformity of heat treatment in normalizing and austenitizing prior to normalizing. The defect was cured by a second normalizing treatment in which uniformity of austenitizing temperature was improved. The modifications of the expansion characteristics of this steel were associated with different carbide structures.

Sheffield University Extension

NEW ENGINEERING BUILDING

A NEW engineering building at Sheffield University, erected at a cost of £500,000, was recently opened by Mr. Selwyn Lloyd, Minister of Defence. Work was begun on the building about five years ago and its completion will enable the University to treble its intake of engineering students.

The new building contains the civil and mechanical engineering departments of the University, leaving the electrical department to expand into some of the space vacated in the original buildings, although the reorganization of this department has as yet barely started. Coincident with the completion of the extensions arrangements are being made for the faculty of engineering, which up to now has had a single professor in charge of all three departments, to be split into three, each with its own professor.

The original engineering buildings of the University were once the technical school and later part of Sheffield University College; in 1905 they became part of the newly constituted University. This year sees the Jubilee of the granting of the charter.

The new building is of the usual type of reinforced concrete frame construction. On the ground floor are those laboratories requiring heavy equipment and considerable headroom—two of these are illustrated—and on the second floor the lighter laboratories, workrooms and a museum. The top floor has lecture and workrooms only. A suite of small rooms is devoted to the photographic needs of the three departments and enables individual students to gain experience of technical photography.

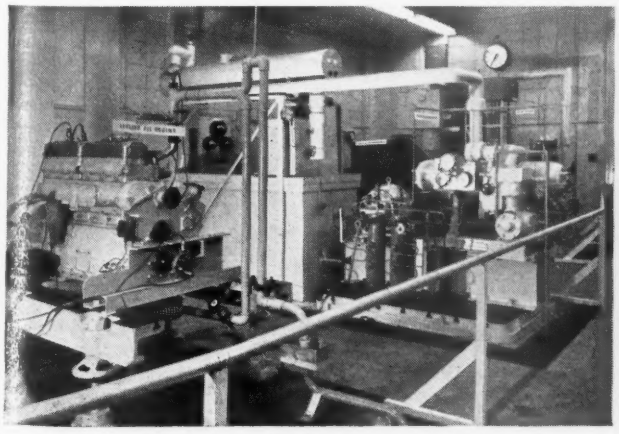
The new civil engineering laboratories comprise principally a well equipped laboratory for investigation on structural models and for determining the mechanical properties of the materials and structural members used; a concrete technology laboratory for testing specimens of plain, reinforced and prestressed concrete, containing two inner rooms in which specimens may be cast and wired under constant atmospheric conditions; and a hydraulics laboratory which is illustrated here. This contains small

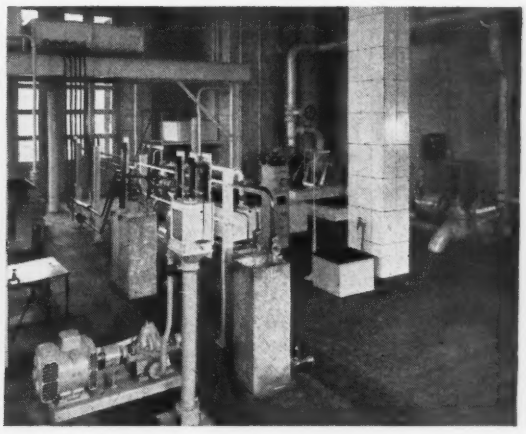
Gilkes Francis and Pelton water turbines among the machines, and an open channel 3ft 6in wide by 3ft deep and 50ft long for towing and model experiments. Pumps and tanks are in a basement which also houses a wave tank for research on wave motion, sediment transportation and drainage problems.

The new mechanical department laboratories include a fine materials testing room, a machines room, a mechanics room and a thermodynamics room, known as the William Ripper laboratory. This contains a good selection of oil, gas and petrol engines, and also a heat pump, seen in the background in our photograph. The engines are all mounted on unit bedplates on concrete plinths, supported in turn by cork pads on a sub-floor. Great care has been taken to minimize noise and vibration transmission to the building fabric. Two variable compression-ratio engines are included for advanced work and an adjoining boiler house supplies a high-speed reciprocating engine, and three steam turbines. To provide electrical loading of plant in this laboratory an 80 kW resistance bank is installed in a fan-cooled duct nearby. A notably well-equipped laboratory is that for metrology where an air conditioned room with double doors and sun blinds enables work of very high accuracy to be done.

The electrical department will have almost twice as much laboratory space upon the completion of the extensions now in progress.

Left: A corner of the thermodynamics laboratory. A Leyland oil engine is in the foreground and a heat pump in the rear.
Right: The hydraulics laboratory





Continuous Strip P

Electronic Control of Coiling and Reeling

By R

MANY different materials are to-day processed or manufactured in the form of a continuous strip, filament or thread, ranging from ferrous or non-ferrous strip metals and similar types of wire, to the textile threads from which cloth is ultimately produced. Examples of producing or processing industries which handle their products in strip or web form are paper, linoleum, plastics, rubber and many others.

In a great majority of processes involving material in a continuous strip form it is necessary to wind the material in the form of a coil or reel at the end of the process and, in some cases, to similarly unwind it at the beginning of the process. It is with the control of the drives to such coiling or reeling arrangements that this article is concerned.

Usually, the material from the process is wound on to a drum having side cheeks to hold the material in place, but in some industries where the coil of material is self-supporting, a core only may be used or this, too, may be omitted and the material wound on a mandrel from which it is removed after the coiling operation.

Reeling Drives

The basic problem which is fundamental to all reeling drives is the fact that as the diameter of the reel or coil of material increases, the amount of material taken from the process with each revolution of the drum also increases. It is not possible, therefore, to drive the core or reel at the same speed as other parts of the machine.

Two simple mechanical methods which have been adopted in an attempt to overcome the problem are the peripheral drive and the slipping clutch. In the first case, the drive to the reel is not applied to the core of the reel but to a roller which presses on to the outside of the material being coiled. The roller is mounted on a swinging arm to allow it to move as the diameter of the coil increases. Since the roller effectively drives the material directly, its linear speed remains constant. The main problems with this type of drive are the maintenance of adequate friction between the drive roller and the reel so as to prevent slip with consequent " scuffing " damage to the material being coiled. The drive to the roller on its moving arm also presents a number of difficulties.

The second method makes use of a friction drive interposed between the drive from the machine and the core of the reel or coil. The speed of the input shaft of the friction drive is arranged so that slip will occur during the whole of the reeling operation, the tension on the strip depending upon the torque transmitted by the drive during the coiling operation. Considerable problems in this form of drive are presented by the maintenance of the friction drive arrangements, e.g., conditions in the drive change considerably during use and, in larger drives, the dissipation of the heat generated.

Whilst both forms of drive referred to above have been applied for many years, their disadvantages have long been recognized, and with the continuous increase in processing speeds their application has become more and more difficult.

In order to meet the requirement for more accurate control and operation at ever-increasing speeds, considerable development has taken place in electronically controlled drives which will provide the necessary characteristics to enable the core of the reel to be directly driven from an electric motor.

The direct drive may take one of two basic forms, either the linear speed of the material or its tension being controlled. In either case, the drive has to compensate for the fact that, as the diameter of the coil increases, more material will be coiled at each revolution and either the linear speed or the tension consequently increases.

If the reeling drive determines the speed of the material, tension being applied elsewhere in the machine or process, it is necessary to control the linear speed or, if the speed is determined by the earlier part of the machine or process, the tension will be the controlled parameter.

In either case, the speed of the drive has to vary in inverse proportion to the diameter of the reel in order to compensate for the increase in coil diameter or " build-up," as will be seen from the following equations outlining the relationship between the various factors during the coiling operation. These equations neglect, however, the effects of friction, motor windage and similar factors.

The speed of the strip V at any instantaneous radius of the reel R will be:—

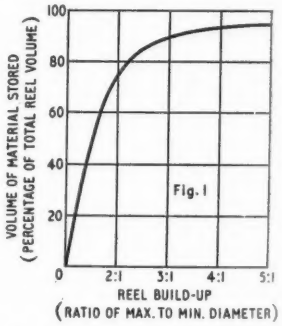
$$V = 2\pi nR$$

where n is the rotational speed of the motor driving the reel. The torque T required from the motor for any given strip tension P will be:—

$$T = PR$$

and the motor power W will be:—

$$W = 2\pi nT$$



From the above, it will be clear that if the speed of the drive is adjusted to maintain a constant linear speed of strip, the power required during the reeling operation would then be:—

$$W = VP = 2\pi nPR = \text{constant}$$

Thus the requirement from the driving motor is for a range of speed control corresponding to the build-up ratio of the reel, the motor providing constant horse-power over this range.

The control of the field excitation of a shunt wound d.c. motor provides a convenient means of obtaining a range of speed control with the required characteristic. The speed range is limited to 3:1 or, at the most, 4:1, by commutation problems and by saturation of the field, so that difficulties are encountered in providing for build-up ranges in excess of these limits.

In considering a reeling or coiling problem, the first factor which has to be taken into account, is, therefore, the build-up ratio. A build-up of 3:1 can be readily dealt with but, as will be seen later, greater ratios involve considerable complication in the control arrangements. In many applications, a limitation is set by the outside diameter of the reel, either from a handling viewpoint or, where high linear speeds are involved, by the peripheral speed and stored energy in the full reel. It is interesting to note from Fig. 1, therefore, that increasing the build-up range beyond about 3:1 by decreasing the core diameter does not result in an appreciable increase in storage. In new applications where automatic control is being considered from the outset, the control problem is made considerably easier if the build-up is limited to 3:1. In

Production

By R. J. F. HOWARD*

the past, however, many types of reel have been designed to have a core size based purely on considerations of mechanical strength and build-up ratios of up to as much as 10:1 may be encountered.

Having shown that a shunt wound d.c. motor meets the drive requirements during the build-up, the problem of automatically controlling the speed during the build-up can be examined.

Modern automatic controls for reeling drives, as in so many other types of control, make use of the closed loop servo system, in which the controlled parameter is measured electrically and the resulting signal compared, in a subtractive sense, with a reference, any difference or error signal being used to correct the system conditions so as to minimize the error.

In applications where it is desired to provide constant linear speed, it is necessary to first measure the linear speed of the material. The most convenient means of making such a measurement is to couple a suitable type of tachometer generator to a roller which is driven by the material, the output voltage of the tachogenerator being proportional to the material speed. This voltage is then compared in a subtractive sense with a highly stable reference voltage, the error signal controlling, through a suitable amplifier, the excitation of the coiler motor field. Thus, as the linear speed tends to increase due to the increasing diameter of the coil, the tachogenerator output will also tend to increase and consequently strengthen the motor field and so maintain constant linear speed. Fig. 2 is a diagrammatic representation of this scheme. The actual control arrangements for the motor field may take various forms, the most usual being thyratron rectifiers providing an easily controlled d.c. excitation from the a.c. supply.

Apart from the automatic control over the build-up range, a frequent requirement for adjustment of the linear speed can readily be provided by controlling the armature voltage to the coiler motor. For a given strip tension the need is for constant torque, and the characteristic of the shunt wound d.c. motor again meets this requirement. The armature may be fed from controlled thyratron or other types of rectifier or from an electronically controlled Ward-Leonard set.

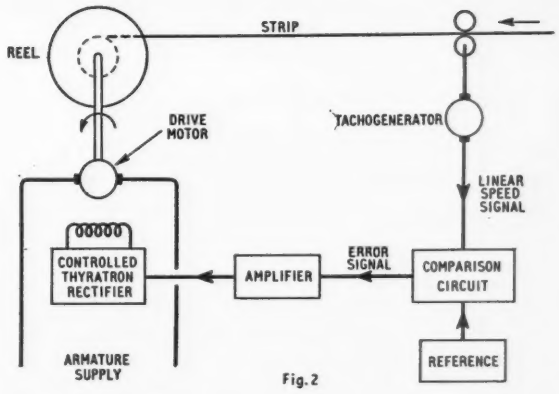


Fig. 2

It should be noted that in constant linear speed reeling, the line speed is determined by the reeling arrangements, and preceding sections of the process can only affect the tension of the strip. Where such tension is applied by a friction device, the accurate control of linear speed will materially assist in maintaining a more constant tension.

The drive to the tachogenerator measuring the linear speed is usually obtained by means of a roller or rollers in contact with the material and it is important to ensure that sufficient torque can be obtained without slip occurring. Where particularly delicate materials are involved, a form of electronic tachometer can be applied in place of the more usual permanent magnet a.c. or d.c. generator so as to reduce the torque requirement to the absolute minimum.

Problems occasionally arise where the linear speed is particularly slow and it is virtually impossible to drive the tachogenerator at a high enough speed to provide output for control purposes. In these circumstances and in others where it is not possible to directly measure the linear speed, control can be obtained by measuring the reel diameter. This is achieved by having a roller bearing on the outside of the coil, the roller being carried on an arm which moves as the reel diameter increases. A pick-off device is coupled to the arm so as to provide an electrical signal proportional to diameter. This is fed to the control equipment which is, in this case, arranged to provide control of the reel driving motor speed which is in inverse proportion to the position of the arm and hence to the diameter of the reel. This arrangement is shown in the diagram in Fig. 2.

Having discussed applications involving constant linear speed control, we can turn to those cases where the linear speed of material is determined by the process or machine preceding the coiler and the coiler is required to maintain constant tension. The conditions during build-up are similar to those for constant linear speed coiling and the speed will again decrease as the reel diameter increases. Since the tension is being controlled, the field excitation has to be regulated from a signal obtained from a tension measurement.

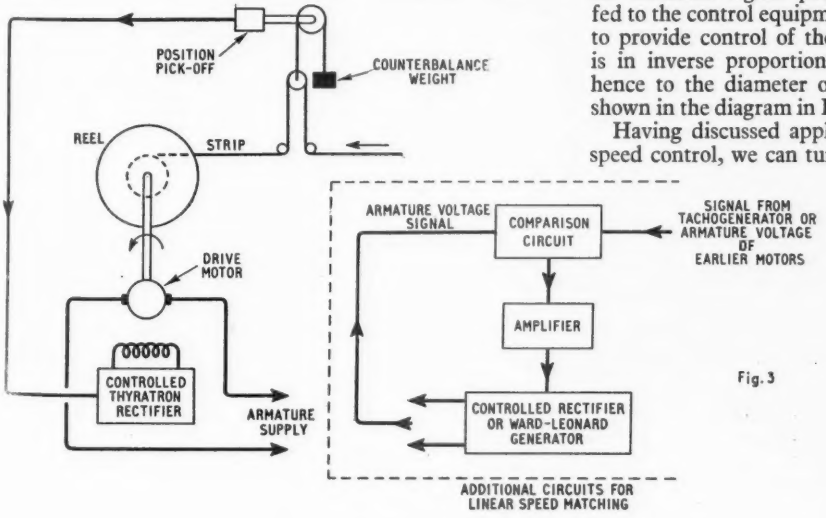


Fig. 3

* Mr. Howard is with Lancashire Dynamo Electronic Products, Ltd.

The simplest form of tension measuring arrangement makes use of a counterbalanced dancer or jockey roller as shown in Fig. 3, the tension being determined by the weight of the counterbalance. If the tension increases, the dancer roller will move and an electrical signal obtained from this movement is used to control the field excitation of the motor. Thus, as the increasing diameter of the coil tends to cause an increase in tension, the movement of the jockey roller automatically adjusts the speed of the coiler to hold the tension constant.

Since the speed of the material is determined by the machine or process preceding the coiler, if this speed is changed it is necessary to change the armature voltage of the coiler motor accordingly. The automatic tension control circuits would change the speed in order to correct for any changes in linear speed, but since these changes call for constant torque rather than constant horse-power, the armature control range of the coiler motor can be better used for this form of control. In any case, the limited field control range is normally fully occupied by the automatic tension control function.

Where the other motors of the machine are fed from a d.c. supply from a Ward-Leonard set or suitable type of controlled rectifier, the armature of the coiler is frequently arranged to be in parallel with these machines, thus providing the adjustment of armature voltage at the same time as that on the remaining machines.

In cases where independent control of the coiler armature is provided separately from a Ward-Leonard set or controlled thyratron or similar rectifier, the armature voltage can be automatically matched with that of remaining machines by comparing the two voltages in a subtractive sense in the electronic circuits and utilizing the error signal to regulate the armature voltage of the coiler.

In some instances, such a comparison of voltages is not possible and the armature voltage of the coiler motor is compared with the output of a tachogenerator coupled to an earlier part of the machine, the error signal being used to control the armature voltage of the coiler motor.

Tension Control

The tension measuring arrangements can take several forms other than that of the simple weighted counterbalance shown as an example, although the requirements of many applications have been successfully met by this simple arrangement. A disadvantage of the system is the fact that adjustment of the tension can only be made by varying the weight on the counterbalance.

It is possible, however, to provide a fully automatic system which will give a close approximation to constant tension, this making use of the fact that, if a constant input horse-power is maintained, the tension will remain constant. In this system, the tension is measured indirectly in terms of the armature current of the coiler motor. The signal obtained from the current measuring arrangement is compared with a reference and the error signal used to regulate the field excitation of the motor so that the current is held constant. Thus, any tendency for the tension and hence the current to rise due to the build-up on the reel will result in the speed being automatically reduced by reason of the strengthening of the field and the input horse-power being held constant.

The general arrangement of this scheme is shown in Fig. 4. The method of control is approximate because the current in the motor armature will also depend upon frictional and other losses in the system. This is particularly the case where the reel is driven through the gearing, since this will introduce losses which will increase the armature current for a given tension. It is important, therefore, carefully to consider the application and to take account of the fact that the accuracy of tension control will depend upon the losses in the system. Where highly accurate control of tension is important, a direct tension measuring arrangement is indispensable. Nevertheless, for many applications, the fact that a fingertip control of tension over ranges of say 6:1 or more is available at the control desk outweighs the fact that the tension regulation accuracy is somewhat lower than that in the direct measurement system.

An important point which must be borne in mind in any tension control system is that the earlier part of the machine or process shall be capable of holding the speed of the strip constant at the maximum tension, i.e., that no slip or overdrive can occur. This point is sometimes overlooked when applying coilers having high levels of tension to existing machines or processes.

During all the foregoing discussion it has been assumed that the build-up on the reel does not exceed the 3:1 ratio which can be covered by the 3:1 range of control available on the field of the coiler motor. In cases where a greater build-up ratio is involved and where constant linear speed control or constant tension control by dancer roller is involved, the control systems described above can be arranged to cover part of the armature control range in addition to the field control range. The constant horse-power requirement does mean, however, that the size of the motor has to be increased accordingly. The following example clearly shows this fact.

Taking a reeling drive with a build-up range of 3:1 in which 5 h.p. is required for providing the necessary strip tension and a motor speed at full armature voltage and full field excitation of 1,000 r.p.m., the motor speed under empty reel conditions, i.e., minimum field excitation, will be 3,000 r.p.m. In a similar drive with a build-up of 6:1 utilizing part armature control, the condition for full reel will be half armature voltage and full field, the speed now being 500 r.p.m. Since, however, constant horse-power is required over the build-up of 6:1 and the motor will only provide constant torque over the armature control range, it will be necessary to use a motor having a rating of 10 h.p. at the full field and full armature voltage conditions of 1,000 r.p.m. in order that the motor shall be capable of delivering 5 h.p. at 500 r.p.m. It will be seen that the doubling of the build-up range has resulted in the motor size being doubled, apart from increased complexity in the control equipment.

The scheme outlined above cannot be used in constant input horse-power tension control systems, but an alternative arrangement of this type which has been successfully applied to reeling drives with a build-up ratio of up to 10:1, makes use of a two ratio gearbox interposed between the motor and the reel. Taking an example with 9:1

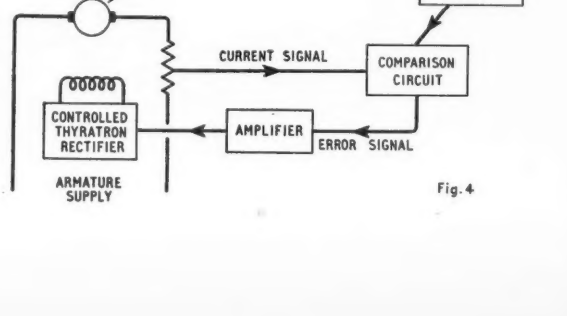


Fig. 4

build-up, the drive is arranged so that control is provided over the 3:1 field control range for the first half of the build-up. As soon as full field excitation is reached, the motor is automatically stopped and an indicator shows that a gear change is necessary. This operation, which introduces a 3:1 change in gear ratio, is performed manually, interlocked switching automatically setting the drive to weak field conditions. On re-starting, the drive automatically runs through the 3:1 field range again, in this case with the reel driving shaft at the lower speed due to the interposed gearbox. In this way, a range of 9:1 is achieved with effectively constant horse-power. Where fully automatic control is required, the gear changing operation can be undertaken electrically, provided a suitable design of gearbox and associated mechanical drive arrangement is incorporated.

A recent development which enables the field control range to be utilized twice and which omits the two-ratio gearbox, provides an automatic reduction in armature voltage and increase in armature current when the full field condition is first reached, the field range being run through a second time at the reduced armature voltage condition. Again, as in the case of the armature plus field control arrangement described earlier, the motor size will increase by the same factor as the increase over the basic 3:1 control range. The arrangement does, however, offer the ease of tension adjustment of the constant input horse-power over extended build-up ranges without the need for introducing mechanical complications in the drive.

It will be seen that electronic control techniques can be arranged to meet the requirements of almost every type of reeling and coiling drive problem, although the cost and complexity will be materially increased where a large build-up ratio is involved.

NEW BOOKS

Active Networks. By V. C. Rideout. Pp. 485; figs. Constable & Co., Ltd., 10, Orange Street, London, W.C.2. Price 42s.

This book covers not only valve networks but all networks capable of amplification. Thus, it deals with transistors, magnetic amplifiers, grid-controlled gas tubes and servo-mechanisms on the common basis of the four terminal network. In addition to the topics usually included in textbooks on electronics, there is a chapter on noise and information theory. The material has been used for a course to senior electrical engineering students, and is rather more advanced than usual. Transient response is treated fairly fully, using the Laplace transform method, and the treatment of modulation and demodulation, extending over three chapters, is very thorough. Modern techniques, such as time-division multiplex and pulse code modulation are discussed to a limited extent. Wave-shaping circuits and relaxation oscillations have a chapter each.

The book serves as a very good course in the application of valves and transistors, both in communications and in industrial electronics, and therefore carries out the aim of the author. It is less satisfactory in its description of the internal operation of electronic devices, which are reduced to mere summaries. In some cases adequate references to the original descriptions are given, but there is, for instance, no reference to a basic paper on transistor operation or to Shockley's book. The mathematics are very clearly written, and many engineers would find the book useful for reference purposes. The printing, presumably by a reproduction process, was rather smudged in the copy we read, and some of the photographic reproductions were practically unrecognizable.—A.H.B.

Electric Transmission and Distribution. Edited by Bernhardt G. A. Skrotzki. Pp. 448; figs. McGraw-Hill Publishing Co., Ltd., 95, Farringdon Street, London, E.C.4. Price 56s 6d in the United Kingdom.

This book has two faults frequently found in American technical works, both of which can only influence practising engineers against it—and only established engineers could afford a book of this price. These are firstly, that it attempts to cover far too much ground relative to its title, and secondly that the first ninety pages are devoted to an account of elementary electrical theory from definitions of a volt and Ohm's law to the theories of leakage reactance in transformers. While the elementary theory is very necessary it is unlikely to be needed by anyone buying this book, or indeed by anyone reaching the stage of specialization implied by the title.

In contrast to this the chapter on transmission contains no account of the theory underlying high voltage transmission over long distance but confines itself to a staccato account of the practical details of construction and arrangement. The chapter on distribution is better but a later one on protection would benefit by more theory to help out the text. Also included are chapters on street lighting, on planning and load characteristics and an auxiliary plant including rectifiers, synchronous convertors and voltage regulators, all of which would be better not included.—H.R.M.

Soil Warming by Electricity. By R. H. Coombes. Pp. 116; figs. Cassell & Co., Ltd., 37-38, St. Andrew's Hill, Queen Victoria Street, London, E.C.4. Price 10s 6d.

The author is to be admired as being one of the pioneers in the commercial use of soil warming by electricity and that part of his book which deals with his adventures in this sphere will be read with interest by many electrical and gardening readers. Nevertheless, despite the title soil warming takes up a comparatively small part of the book, which is mostly devoted to horticultural details of soil and crops. Much of the information in this section is debatable and some, indeed, open to criticism. It is particularly unfortunate that no attempt has been made to show any cultural or economic advantage from using soil warming with any of the crops listed.

Another surprising omission is that while the author refers to authoritative work having been done and quotes some of the results, he omits the customary step of giving a reference to such technical reports and other publications from which the information is taken. Indeed, if it were the author's intention to encourage people to use electrical soil warming he might have been more successful in so doing if he had not only given such a bibliography but also had referred to the considerable development in commercial application in soil warming since its early days and had given the reader a more realistic picture of the tremendous strides which have been taken in this horticultural technique. While therefore something of an interesting landmark, this book will probably disappoint a number of its readers who had hoped to find it more constructively informative on the subject to which the title would appear to refer.—A.W.G.

I.E.E. Annual Report

Copies of the annual report of the Council of the Institution of Electrical Engineers for the session 1954-55 and of the accounts for the year ended 31st December, 1954, to be presented at the annual general meeting on 19th May can now be obtained by members of the Institution on application to the secretary. The annual general meeting will be followed by a lecture by Lord Citrine on "Human Relations in Industry."

ELECTRICAL RESEARCH

Points from the E.R.A. Annual Report

In a foreword to the thirty-fourth annual report of the British Electrical and Allied Industries' Research Association for the year ended 31st December, 1954, Mr. C. T. Melling, chairman of the Council, indicates a year of progress—progress in the research work of the Association; in the building of the new laboratories at Leatherhead; and in the increasing response which the various sections of the electrical industry have made to the work of the Association. And coupled with this progress he pays tribute to the valuable services during the past year of the president, Sir Lawrence Bragg.

Association's Accounts

Both the Association's total income and its industrial income have risen. This increase has come partly from larger subscriptions from existing members and partly from the accession of a number of new members. Among them is the National Coal Board, the fourth nationalized industry to support the E.R.A. There has also been an increase in special contributions from industrial and Government sources.

The accounts show a nominal surplus of income over expenditure, excluding the capital transactions involved in the building work at Leatherhead. The receipt of certain contributions in advance of the inception of one or two expensive new projects has inflated the apparent surplus this year. The Association is still unable to meet all the strongly supported requests for research and, in addition, the Council desires that long-term fundamental research should be increased, because its proportion has fallen of late by reason of the pressure of urgent work for immediate application. Efforts to increase income, therefore, continue. Only a modest strengthening of the research and technical staff has proved feasible, together with an economy in non-technical services. The cash position has permitted so far the temporary financing of capital expenditure which would have involved the loss of both capital and income had it been necessary to realize investments in present market conditions.

Although E.R.A. Patents, Ltd., has carried out no large financial operations during the year, a number of E.R.A. inventions and developments have been adopted by members, either by licences under patents or with the Association's assistance without patent protection.

The new buildings at Leatherhead are now fairly well advanced, and the expected date of occupation is the spring of 1956, which allows a small margin on the contract time. At a Press conference in October last, the chairman stated that capital contributions paid or promised had reached £197,500, and that it was necessary not just to reach the £200,000 which secures a D.S.I.R. capital grant of up to £100,000, but also to ensure that all members contributed to what would then be a co-operative effort in the fullest sense.

Events during the year have brought into prominence the part played by the E.R.A. on a wider stage, both by reason of its membership throughout the British Commonwealth and by its international repute. At the I.E.C. Jubilee Meeting in Philadelphia this year Dr. Whitney presented the research basis of proposals on flameproof gear, with which he was so long associated as head of the department on switch and control gear and is still associated with in a part-time capacity. The relevant I.E.C. technical committee applauded his presentation and the only research which Lord Waverley mentioned in his general address to the Conference was that on flameproof gear.

Mr. Golding presented a paper on wind power plants at the World Power Conference in Brazil and visited Trinidad and Haiti (at the request of the Haiti Government and the World Meteorological Organization). With Mr. Stodhart he made an energy survey of Somaliland, sponsored by UNESCO and the Protectorate Government, as a typical arid zone.

In addition to assistance with large heat pump installations (particularly those of the B.E.A. and Area Boards) and the successful operation of the Shinfield heat pump, two commercial designs of the double-purpose heat pump for larder cooling and water heating came on the market this year.

At Philadelphia, an International Conference on the Properties of Steam accepted British proposals for future action. During the year Professor Newitt published details of the primary pressure standard for his steam research plant to provide data up to 1,500 deg F and 6,000 lb/sq in.

The surge injector unit for low voltage argon arc welding has been used by a member in welding aluminium cable sheaths, and another member is in course of producing units under E.R.A. British and foreign patents to meet requests from various countries.

Dielectric Investigations

The variation of breakdown voltage with thickness and time in insulation tests has so far remained an unsolved problem. This year Mr. J. H. Mason's work on the effect of discharges on dielectrics has yielded a quantitative explanation over a wide range. Further progress has been made with the new dry oxide dielectric film and on the use of hydrogen-acceptors in impregnated capacitors. The Ministry of Supply supports this work. The long-term programme at the N.P.L. on the electrical properties of newer dielectrics now extends in frequency up to 24,000 Mc/s and in temperature to the higher limits now possible. In parallel a large programme on industrial testing has been pursued, including glass sleevings, cotton covered wires, terylene, cellulose compounds and insulating oils: temperature classification and tracking have received attention.

Fundamental work on dielectrics has included the influence of strong electronic interaction in solids, plasma oscillations in solids and the theoretical effect of dipoles on dielectric breakdown to explain the E.R.A.'s previous experimental discoveries. Theoretical and experimental research on perovskite and related structures is important for high permittivity dielectrics. Work at Perivale on tungsten oxide continues and the study of niobates has been transferred there from Leeds University.

Mr. King and Dr. Bruce have propounded a purely thermal theory of the concentration of arc-like discharges —a general problem so far unsolved, with a particular application to switchgear.

Agreement between theory and experiment has been reached on aspects of surge voltage distribution in trans-

formers and a scale model of a very large transformer is now available. A large model of a transformer substation will reduce errors of extrapolation in comparing theory and experiment on the thermal problems of transformer operation. The work reported last year continues on axial forces on windings and transformer noise.

The electrical characteristics of overhead lines, already issued to members, will soon be published as a book. A summary for daily use has been issued. Research bears mainly on the vibration of conductors, effect of polluted atmospheres and atmospheres and efficiency of arcing devices (Queen Mary College).

The P.M.G.'s regulations for the abatement of radio interference from refrigerators and small motors, like the regulations for ignition systems, will be limited to sound broadcasting bands and Television Band I.

The E.R.A. network analyser which was inaugurated in April, 1954 (*Electrical Review*, 7th May, 1954), has successfully met the needs of a variety of problems posed by members covering regulation, surge protection, self-excitation and a search for sources of overvoltage in a large supply network.

A good deal of material on earthing and earth continuity has been sent to the I.E.E. and Codes of Practice Council, since both the Code of Practice on Earthing and the thirteenth edition of the Wiring Regulations will meet pressing needs. Analysis of data on fires associated with electrical installations is proceeding.

Following the E.R.A.'s examination of the supply and use of selenium, germanium and other scarce materials needed by the electrical industry, the D.S.I.R. has taken administrative action and has put technical studies in hand.

Technical Liaison

This year the Association held the first of its group discussions in connection with technical liaison and information, and Mr. Baxter, whose book on "Electric Fuses" has had an excellent reception, introduced some recent reports on fuses to representatives of interested members. This was exceedingly helpful to the staff and the relevant E.R.A. committee. A number of technical liaison visits have been paid during the year and many technical enquiries have been pursued. Members have shown great appreciation of these services and technical liaison has played a major part in the increase of membership already mentioned. The Information Bureau and Library deal with the growing number of inquiries which can be answered from reports and published literature. Although there has been some strengthening of the translation, bibliography, abstracting and loan services, they are fully extended.

Work has been done on 70 or so selected research subjects under eighteen broad headings, viz., insulation and dielectrics, switch and control gear, steam power plant and condensers, problems ancillary to coal combustion, wind power generation, insulated cables, overhead lines, transmission of power at high voltages, surge phenomena, communication interference, magnetic materials, transformers, earthing, safety and circuit problems, integrating meters, rural electrification, heating, cooking and allied problems, electrical equipment of automotive systems, and unclassified researches.

The Weekly Abstracting Service continues to give satisfaction to its subscribers. An average of 30 abstracts are given every week, taken from about 400 different British and foreign journals to which the Association subscribes annually, and the journals containing the articles abstracted are available on loan. These loans amounted to between 6,000 and 7,000 during the past year. Translations of articles from the foreign journals are made on request where it is found that they are of interest to sufficient members. Some 70 translations have been made this year for members and the technical staff, and a list is given in the Report.

Seventy-eight new reports (also listed) have been issued to members. Those published in full or in modified form in the technical or scientific Press, and also articles contributed by members of the E.R.A. staff or by extra-mural research workers, are listed in the Report.

A feature of the Report is the organization chart which shows the composition of the governing body, the E.R.A. Council, and of the committees and sub-committees, which are engaged on the numerous subjects.

The members of all the committees are listed, and finally there are lists of the senior staff members headed, of course, by the director, Dr. S. Whitehead, M.A., M.I.E.E., F.Inst.P., and the secretary, Mr. R. A. McMahon, M.I.E.E., and of the honorary members and member firms.

THE ANNUAL LUNCHEON

In proposing the toast "The E.R.A." at the annual luncheon on 4th May at the Savoy Hotel, Lord Woolton, P.C., C.H., said it was gratifying to see that in the present days of the Association's greatness it still relied to some extent on the research work of the universities because it was there that much of the fundamental research was carried on. If that fundamental research in the universities could be associated with similar research work done in the Association's own laboratories, there might be great advantage not only for the industry but for the nation as a whole.

He was personally convinced that such fundamental research and its application were the very life blood of scientific industrial progress. He knew that very often the question was asked whether it was really worth while carrying on these researches which did not have any immediate prospect of profit or even of application. He was personally convinced that it was.

This country had been criticized, quite justly in his view, by the Americans for the fact that it had concentrated so much on maintaining leadership in pure research that it had not bothered to direct its efforts towards applying it. The country had carried out the research and had quite rightly got the credit for it, but had let somebody else get the profit from it. That seemed to be rather foolish, but it did not mean that fundamental research should be given up. It meant that more energy should be devoted to seeing that the full advantage was obtained from it. That, he believed, was about to happen. The country had now become convinced that it was necessary to develop the application of technology and of applied science to the industries; that the universities and various learned institutions had to direct their attention in both ways so that fundamental research was continued; and at the same time, that the importance of training the technologist who would enable the full advantage of that to be obtained was recognized. We were living in an age of progress and of very rapid expansion and the future of the Association would be both useful to the community and rewarding to the Association.

The president of the E.R.A., Lord Chandos, P.C., D.S.O., M.C., in response, said that if Stephenson had learned that the General Electric Company of America had produced out of a single shop generators capable of producing about 10 million horse power, he would have felt a bit frustrated! The rather amazing changes were, however, nothing compared with the changes which would take place in the next fifty years. Wherever one looked there was the realization how in the present age man's ability to create wealth was under-rated. Many of the

existing troubles were due to the fact that it was not realized. The power to create wealth was one of the great features of the present age and it was accelerating every day. It could be said on behalf of the Association that there were few bodies of people who made such a contribution to that power to create wealth as the electrical industry, particularly its research side.

We had in this country to take vigorous measures to see that in seven or eight years we did not fall behind in the rate of progress and sink into being a second-class power. It would seem unusual to our forefathers and paradoxical to think that a country only maintained its position as a first-rate power if it was prepared to devote money, effort, skill, education and inventiveness to the subject of research. It was the only way in which we could live and we were going to get behind unless we took vigorous measures.

Research had to go forward in all fields at once. The internal combustion engine had been developed a good deal in the last fifty years, but when one considered the question of roads it was found that research had not progressed at the same rate. In fact we had the extraordinary situation in this country of finding that a machine costing about £4,000, capable of a silent speed of 120 miles per hour, was actually the slowest means of proceeding from the Mansion House to Charing Cross.

Referring to the White Paper on nuclear energy, which pointed out that in 20 years 20 per cent of the power would be generated by harnessing nuclear energy, the president said that if this country fell behind in that one field alone it would drop out of the world as a leading power, and the people would have to accept a lower standard of life.

The chairman of the Council, Mr. C. T. Melling, C.B.E., M.I.E.E., in proposing the toast "The President," said that the Association had been particularly encouraged each year by the willing response of men who were eminent in science and technology, manufacture and in the supply of electricity to serve as presidents. The present year was no exception and the Association had been greatly encouraged by the ready response to its invitation by Lord Chandos.

A great deal was owed to our salesmen overseas, for without their efforts it would not be possible to purchase the raw materials and food which were required. But while remembering that, it was also well to remember that exports, like charity, began at home. They began in the development of machinery and appliances for practical use in the home market in order to secure improvements and mass production for world competition. In that respect the manufacturers of electrical appliances were greatly assisting in the efforts to increase national exports. At the same time it must be considered that that stage of development began in the research departments. The country was and would continue to be dependent on research for its prosperity.

He thanked all members for their financial and other support of the Association, and for the ready way in which facilities were provided for engineers, chemists and physicists to sit on the research committees.

Stockholders' Inspection

AT the recent annual meeting of Associated Electrical Industries, Ltd., Lord Chandos, the chairman, said that it was proposed to give stockholders an opportunity of seeing for themselves some of the work of the group. About a thousand stockholders subsequently expressed interest in the idea; it was not possible to invite them all to visit the works and about 400 were chosen by ballot to see two of the main works—the Metropolitan-Vickers factories at Trafford Park, Manchester, and those of the British Thomson-Houston Co. at Rugby—in approximately equal parties. Special trains from London were chartered for the occasion, luncheon being served on the way, and some stockholders proceeded to the works independently.

One of the factories seen by A.E.I. stockholders was the B.T.H. heavy plant factory. In the foreground of this view is the stator of the first of two 66,667 kVA, 150 r.p.m. vertical waterwheel alternators for the Eildon power station (Victorian State Electricity Commission) and in the background the six sections of the stator of a 44,444 kVA, 136·4 r.p.m. vertical waterwheel alternator for Roxburgh, New Zealand, one of four machines being made by B.T.H.

At Trafford Park on 3rd May the visitors were shown the principal activities, including the production of steam turbines, generators, transformers and control gear. They were also given a demonstration in the research laboratories. Afterwards they took tea with some of the principal officials of the works and were welcomed by Dr. C. Dannatt, managing director of the Metropolitan-Vickers group.

The other party travelled to Rugby on 5th May and arrived at the B.T.H. works after luncheon on the train. Most of the time was spent in the heavy engineering shops but an opportunity was given the visitors to see the laboratories. They then went over to the Lamp Works which gave them an insight into the intricate processes involved in the production of incandescent lamps. At tea in the works canteen Mr. E. H. Ball, managing director of the B.T.H. Co., gave an outline of the company's structure and character, stressing the fact that A.E.I. employees were being given a chance to take a financial interest in their organization.

Well-illustrated souvenir booklets were handed to the shareholders taking part in these inspections giving them a clear picture of the organization and activities of the A.E.I. companies.

Heat Treatment of Tools

New Birmingham Laboratory

LAST week we had the opportunity of inspecting the new heat treatment division of Uddeholm, Ltd., a subsidiary of one of Sweden's largest steel enterprises, officially opened at the company's Crown Works in Birmingham by the Lord Mayor of Birmingham on 3rd May. Founded nearly 300 years ago, the Uddeholm Company handles the production of steels from ore to finished product and to-day over 50 varieties of these steels, each with its own characteristics, are supplied to the British tool maker in soft annealed form for machining. Their different properties are imparted not merely by the addition of suitable alloys and careful metallurgical control in melting and fabrication, but also by the final heat treatment designed to secure the most suitable microstructure in the finished tool. One specially made high carbon stainless steel costs almost £100 per lb, which illustrates how vital it is for a tool maker who has invested in a costly steel to be able to have it heat treated by the experts responsible for its production.

With this in mind, the new heat treatment division at Birmingham has been formed to provide a service which will enable tools and tool steels to be given a precise heat treatment under conditions normally only associated with a laboratory. The well illuminated heat treatment shop has been equipped to undertake the complete heat treatment of the full range of carbon steels, in the form of hot and cold working tools including punches, blanking and drawing dies as well as moulds for plastics and other intricate work and includes all the equipment necessary for modern heat treatment techniques. The installation is made up of several small furnaces and ancillary equipment allowing the employment of small easily handled charges with resultant constant expert supervision through all stages of treatment. There are eight separate and independently controlled electric furnaces of four distinct types, four quench tanks providing oil and water quenching, and a low temperature oven, all of which, together with other electrical apparatus including

Part of the furnace installation showing salt baths and one of the oil quench tanks

General view of the heat treatment shop

lighting, ventilation and substation equipment, were supplied by the General Electric Co., Ltd.

The heat treatment of tools commences with pre-heating generally to a temperature of up to 700 deg C before treatment in salt baths and for this the shop is equipped with two forced air circulation furnaces with loadings of 20 and 30 kW respectively. The smaller one employs a charge carrying basket 20in in diameter and 18in deep; the larger has a basket 20in in diameter and 30in deep. To allow air circulation round the tools, these baskets have perforated bottom plates. Vigorous air circulation, provided by a centrifugal fan, ensures uniformity of temperature and makes possible precise control of the low temperatures used. To prevent loss of heat, the chamber is effectively sealed by an easily operated lift and swing lid. Automatic temperature control is provided for both furnaces.

Three electrode salt baths provide a range of operating temperatures for the hardening of tools and dies and ensure rapid and uniform heating whilst providing protection from scaling and decarburization. A 37·5 kW salt bath gives temperatures up to 1,350 deg C, meeting the requirements for hardening high-speed steels and certain hot die steels, and two baths each of 36 kW rating are used for the bright hardening of tool steels, operating at temperatures up to 1,000 deg C and 950 deg C respectively. All furnaces have automatic temperature controllers. In addition there are two 15 kW rectangular salt baths heated by immersion elements. One provides temperatures up to 350 deg C and is used for tempering tool steels to reduce risks of cracking and distortion and the other gives temperatures up to 600 deg C and is suitable for the secondary hardening of high-speed and hot die steels. The molten salt is kept in circulation by a removable electrically driven stirring paddle. A 30 kW horizontal batch furnace is installed for hardening and pack carburizing of tools which are too large for salt bath treatment, and for annealing. For water quenching, one 400 and one 200 gal tank containing a 5 per cent caustic soda solution are used. Oil quench tanks of 450 and 300 gal capacity contain immersion heaters to raise the oil to the normal quenching temperature of 40 to 50 deg C. An electrically driven paddle stirrer maintains circulation of the oil. To ensure that all work is double tempered, a forced air circulation oven giving a maximum operating temperature of 400 deg C is used for the selective tempering of tools after hardening. A modern warehouse, under the same roof as the heat treatment shop, enables Uddeholm, Ltd., to offer a comprehensive stock of the full range of tool steels, comprising straight carbon steels, oil hardening steels, high carbon, high chrome steels and high-speed steels.

SEMI-CONDUCTOR DEVICES

I.E.E. Radio Section Papers

FIVE papers on transistors and other semi-conductors were presented before the Radio Section of the Institution of Electrical Engineers on 11th May. The first, by Mr. W. L. Stephenson (Mullard Research), related to an investigation to determine the variation of junction-transistor noise within the frequency range of 7 to 50 kc/s. The author reported that: the noise factor reached a minimum at 25 kc/s as the frequency was increased and rose thereafter; the optimum source resistance was independent of frequency and was not directly related to input resistance; the noise was completely independent of collector voltage. The last-named result contradicted published results of many other experiments with early transistors which were not hermetically sealed.

Noise fluctuation in silicon microwave diodes was discussed by Mr. G. R. Nicoll (Radar Research Establishment) in the light of measurements when point-contact diodes were subjected to d.c. bias. It was found that flicker noise (the cause of which was not yet fully understood), which was dominant up to 1,600 c/s, might be greater than shot noise up to and probably appreciably above 45 Mc/s. Diodes with low flicker noise showed, for small bias currents, good agreement at 45 Mc/s with calculated values for shot noise. Noise ratios less than unity might occur for forward bias currents, on reduction of which the shot noise smoothed to the magnitude expected for thermal noise, confirming that thermal noise for zero bias could be calculated in terms of the shot-noise concept. Microwave noise between 30,000 and 40,000 Mc/s produced by reverse bias was probably attributable entirely to shot noise. Noisy mixer action was shown to be due to a large component of flicker noise.

Particulars of a transistor relaxation-oscillator circuit and of its operation as a d.c. step-up device were given by Mr. L. H. Light and Mrs. P. M. Hooker (Mullard Radio Valve Co.). The transistor acted as an interrupter in a low voltage circuit; energy stored during the " on " period in the transformer inductance was delivered to the output circuit at an increased voltage during the " off " period. Advantages of transistor convertors over other methods at power levels of a fraction of a milliwatt up to several watts included high efficiency, long life and small size and weight. They were, however, subject to temperature limitations associated with semi-conductors, which would not, however, be serious when silicon devices became generally available.

Factors governing the power handling capabilities of p-n-p junction transistors in sinusoidal amplifiers were considered by Messrs. R. R. Hilbourne and D. D. Jones (G.E.C. Research). The maximum allowed collector dissipation, they stated, did not necessarily indicate the limit to the power output possible. Variation of current gain over the required range of emitter current must be kept below a value determined from the amount of tolerable distortion. After dealing in detail with Class A amplifiers and three Class B push-pull arrangements, it was concluded that the merits of the common-collector Class B amplifier favoured its use. In the Class A type the transistor was so biased that neither the collector current nor voltage was cut off during any part of the input waveform; its efficiency in practice might reach 48 per cent for a sinusoidal input. In a Class B amplifier the transistor was so biased that amplification occurred only over one half of the input waveform; efficiencies of 70 per cent or greater had been obtained using junction transistors.

A new type of germanium-junction photo-electric cell, in which the junction was made by impurity diffusion, was described by Mr. J. M. Waddell and Dr. S. E. Mayer (Standard Telephones) and Mr. S. Kaye (formerly with Standard Telephones). Its advantages were stated as small size, large output, good sensitivity and stable characteristics with low noise level. Temperature rise rather than absolute temperature was shown to be the important criterion in determining maximum ratings. Its spectral response differed from that of previous types in having an extended long-wave cut-off. It could be applied, for instance, to a simple magnetic amplifier making use of the high forward conductance of a photocell.

Medical Uses of Radioactive Isotopes

A LECTURE on the medical uses of radioactive isotopes was given to the Measurements Section of the Institution of Electrical Engineers by Prof. H. V. Mayneord on 3rd May. In the course of this, he said it was to be expected that the first of the applications of the new radioactive isotopes would be in irradiation therapy as an obvious extension of the use of high-voltage X-rays. He felt that that particular phase was going, and the subject was turning now to the use of the materials for diagnostic physiological applications. By the use of radioactive isotopes many subjects could be studied including bone destruction, regeneration, and diseases of the thyroid. It was also possible sometimes to use the uptake of radioactive isotopes to try to locate the position and size of tumours.

To the physicist, the chemist and to some extent the physiologist the radioactive materials fell into two main groups. One group was manufactured by placing stable materials in the chain reacting pile and making new radioactive isotopes. The classical example in medicine was placing normal cobalt with a mass number 59 in the pile to capture neutrons and form cobalt 60. It was, however, very difficult unless there was very large neutron flux to produce high specific activities, because the chemical application of the isotope was not an easy matter. The other great group of radioactive materials used in medicine were fission products, for example, Uranium 235. Those manufactured in the processes in the pile were radioactive isotopes with high specific activities. Clearly specific activity must be very high because every atom was potentially radioactive. There were a great number of isotopes, and he gave the example of his own department, where there were 20 or 25 either used clinically or studied with a view to clinical use.

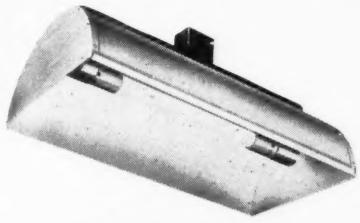
Having shown a number of slides of applicators, equipment and results of treatment, Professor Mayneord pointed out that when it was desired to irradiate small surface lesions, often only a millimetre thick, beta rays were used. A beta ray of 2 MeV would travel roughly 1 centimetre in water, so that when high voltage beta emitters were used, it could be reckoned that a useful dose could be given to a depth of a few millimetres at least.

NEW ELECTRICAL EQUIPMENT

Fitting for 1 kW Mercury Lamp

A special reflector fitting, M2560, is now available for use with the Mazda 1 kW horizontally operated mercury arc lamp recently introduced by the BRITISH THOMSON-HOUSTON CO., LTD., Crown House, Aldwych, London, W.C.2.

The fitting has a cast aluminium alloy main channel finished in green, mounting an anodized aluminium trough reflector. A removable side



Mazda mercury lamp fitting

panel in the main channel gives access to a porcelain connector block, ready wired to the two special spring-loaded porcelain lampholders. The design of the lampholders aided by a ring on one lamp cap ensures that the lamp is inserted the right way round and in complete safety.

The closed end reflector has a matt finish and gives a nearly symmetrical light distribution. It is easily removable for cleaning. The fitting has been introduced principally for installation at mounting heights of from 25ft to 45ft for lighting interiors. It may be used with a 1,500 W tungsten fitting as a component of a Mazda "blended light" unit.

The horizontal operation of the 1 kW MA/H lamp has great advantages. In a 20 deg cut-off reflector the lamp gives nearly 40 per cent direct light, while indirect light can be simply controlled with an efficiency of about 75 per cent. Used in the Mazda trough reflector fitting, an output of 30,000 lumens is achieved. The lamp and its auxiliary gear operate on standard 200/250 V a.c. supplies. No magnetic arc control is needed.

Industrial Instruments

Following their unit-design policy, GEORGE KENT, LTD., Luton, Bedfordshire, have brought additional instrument series into their "Commander" range of industrial instruments, of which the "KU" flow meter was the first.

The basic construction and mode of presentation apply to all the new instrument series, the actual secondary measuring elements being different in each model. Three of the new types, the "KUP," "KUX," and "KUS," are simple extensions based on the "KU" mercurial flow meter, while in the fourth, the "KP," up to three Bourdon tubes for pressure measurement are substituted for the mercury U-tube. The fifth type, "KT," includes mercury-in-steel primary elements for recording temperature; and the sixth, the "KR" series, uses a mercury U-tube or bellows unit for the remote reception of flow values from a primary measuring and pneumatic-transmission device.

The "KUP" instrument series covers the flow recorder with one or two pressure recordings added. Flow integration, indication (on a sector scale), and automatic control functions may be included in various interchangeable combinations; for the measurement of level, specific gravity, etc., the "KUX" instrument series is available; and the "KUS" series is for measuring flow and level, specific gravity, etc., with indication only from the "Commander" class presentation element.

The "KP" series are Bourdon-tube operated pressure recorders, the "KT" series are temperature recorders with mercury-in-steel primary elements for the measurement of temperatures within the range −35 deg F to +1,100 deg F, and the "KR" series instruments are for the remote recording, indication, integration, and automatic control of flow values.

All instruments in the "Commander" class have a standard door, 18 by 15in, and are supplied for panel, wall, or post mounting.

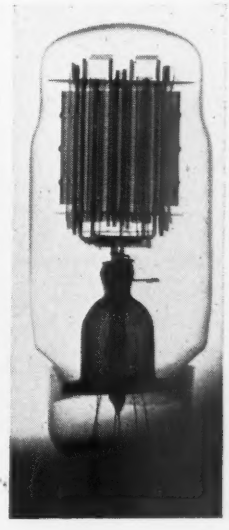
Audio Frequency Amplifier Valve

A new valve, the Osram KT55 beam tetrode, introduced by the GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, London, W.C.2, is designed primarily for use as an audio frequency amplifier in d.c./a.c. equipment using a series connected heater chain. Two of these valves used as pentodes in push-pull are capable of an output of 25 W from a d.c. mains supply of 220 V, double that hitherto obtainable from valves in this class. It can be used in voltage stabilizers and as a source of power for running a.c. gramophone and similar equipment off d.c. mains. The list price is 25s plus 8s 2d purchase tax in this country.

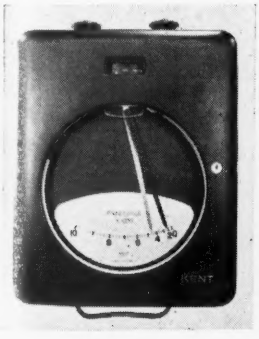
Veterinary X-Ray Unit

An X-ray unit believed to be more powerful than any previously used in British veterinary radiology is installed at the Equine Research Station of the Animal Health Trust at Newmarket. The apparatus is made by WATSON & SONS (ELECTRO-MEDICAL), LTD., East Lane, North Wembley, Middlesex, and comprises a high voltage transformer having an output of 120 kV, 400 mA, connected by shockproof cables to the X-ray tube. The latter is supported on a mobile

X-ray picture of Osram KT55 valve



Radiographing a horse's shoulder



Kent "Commander" "KUS" instrument

tube-stand affording a full range of movement in all directions. The tube-stand can be used either in the operating room or stocks room adjacent to the transformer room, or in the open.

Technically, the most important feature of the apparatus is its extremely high output, which has been made possible by the development of a high power rotating anode X-ray tube (the Machlett Dynamax). This high output shortens the time needed to make a satisfactory radiograph, thereby greatly simplifying the immobilization of the animal during the exposure. Equally important is the fact that the shoulders and other regions in large animals, previously too dense to be penetrated by X-rays in a reasonable time, can be more satisfactorily radiographed.

Aluminium Soldering Tool

The BELARK TOOL & STAMPING CO., LTD., 33, Sussex Place, London, W.2, is producing an electric soldering tool for use by comparatively unskilled labour in the soft soldering of aluminium and its alloys. A 165 W element heats the copper bit in the centre bore of which is a small steel wire brush connected to a vibrator in the body of the tool by a steel rod. The heating element is fed straight from the supply point but the vibrating brush is controlled by a trigger switch.

In use the wire brush vibrates and cleans the surface mechanically while a pool of molten solder around the solder bit protects the spot from air and consequent oxidation. As soon as the oxide film is broken up the molten solder joins the surface. The tool is available for 110, 200/220 and 225/250 V a.c. and costs £14 14s.

Fluorescent Fitting

A new fluorescent lighting fitting, claimed to have a number of unique features, has been introduced by METALFORM, LTD., 258, Grays Inn Road, London, W.C.1. Intended primarily for industrial and commercial use, the fitting is adjustable to give a wide choice of mounting positions and incorporates movable reflectors which can be locked to provide various cut-off values. The fitting is also designed to provide a high proportion of light radiation above the horizontal, to ensure adequate ceiling and surround illumination.

The mounting-plate can be fixed direct to walls or ceiling, to a standard conduit box, or clamped direct to conduit for bench or other locations. For pendant mounting the plate can be attached to two tubular down rods or suspension chains. To simplify installation the mounting plate is a separate unit—after being fixed in position the control gear box, which supports the assembly, is slid on and held firm by fixing screws.

The reflectors are detachable and can be used either singly or together, or they can be reversed to form an indirect lighting fitting. The reflectors and control gear box are fabricated from sheet metal, stove-enamelled in a range of colours. The insides of the reflectors are white.

Shock Tester for Electric Fences

Electric fence users do not like the idea of catching hold of the fence wire to see whether the shock unit is working or to test its effectiveness. A neon light will indicate whether the fence line is working or not but gives no indication as to the strength of shock. To overcome this difficulty the WOLSELEY SHEEP SHEARING MACHINE CO., LTD., Electric Avenue, Witton, Birmingham, has recently introduced a shock tester which enables the user to check the condition of his fence line accurately and satisfy himself as to the degree of efficiency of the installation.

This pocket sized unit consists of a plastic cylinder at one end of which a small adjustable wheel and hook is mounted and at the other end a flexible cable leading to an earth spike. The

Wolseley shock tester

spike is first pushed into the ground, the instrument hooked on the fence line and the knurled wheel rotated clockwise until the built in neon light ceases to flash when the reading on the wheel at this point indicates the strength of shock actually being delivered along the fence line.

Industrial Lighting Fittings

Details have been issued by HOLOPHANE, LTD., Elverton Street, Westminster, London, S.W.1, of a new range of general purpose industrial lighting fittings suitable for installation in high and low bays. These are described in publication ref. 5503.

The low bay units are fitted with new types of 12in and 14in prismatic reflectors providing an efficient "intensive" type light distribution in a lamp range of 200 to 500 W g.l.s. and 80 to 125 W mercury discharge. "Correctalite" glass reflectors are also available for these units giving a degree of colour correction to the light emission of gasfilled lamps sufficient to blend with daylight.

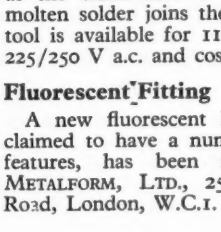
High bay units with heavy duty prismatic reflectors provide an efficient light control for turbine houses, steelworks, engineering shops, foundries, etc. Various sizes are available, giving "focusing" and "intensive" light distributions, suitable for 250 to 400 W mercury discharge lamps and 300 to 1,000 W g.l.s. lamps.

Distribution Boards

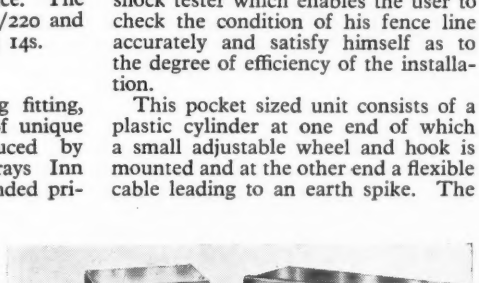
Following on the recent introduction of their "Lupus" miniature circuit-breakers, the M.C.B. Co. (MANCHESTER), LTD., 6, Melrose Avenue, Brooklands, Sale, Manchester, announces new distribution boards incorporating "Lupus" miniature circuit-breakers with the interlocking plug-in system which permits isolation without supply interruption.

When an electrician is working on a circuit he simply pulls out the controlling circuit-breaker. Use is made of the unit assembly principle, each unit comprising a 4-way (or 6-way) skeleton. The slackening of two screws allows complete removal of the box interior, thereby facilitating mounting and wiring.

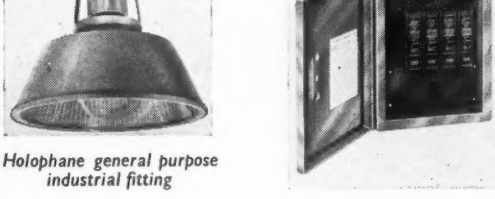
Boxes are 18/16 s.w.g. sheet steel with reinforced back edges and welded corners. Ample cable space is available for top or bottom entry, and boxes can be supplied with or without detachable end-plates. Publication LUPUS/2 giving full particulars is now available from the company.



Holophane general purpose industrial fitting



Distribution board with "Lupus" miniature circuit-breakers



Belark aluminium soldering tool

GENERATION AND DEVELOPMENT

Record Programme in the South West

The South Western Electricity Board plans a record capital programme of £3,300,000 this year—nearly 20 per cent more than last year—to reinforce electricity networks and extend supplies to rural areas, industrial and commercial premises and new housing estates. This information was given by Mr. S. F. Steward, the Board's chairman, last Friday when he presented a challenge cup to the Taunton Service Centre team, winners of the Board's display competition for which there were 90 entries from service centres all over the West Country.

"We are really only just beginning to exploit the immense possibilities of this new electrical age for the benefit of the community as a whole," said Mr. Steward. In the home electric water heaters, cookers and other labour-saving appliances were being installed at a rate which had never been equalled in the past. For the second year in succession the increase in the demand for electricity in the South West had been greater than in any other part of the country. This was more than a "success story" for the Electricity Board; it was the key to the future social and economic progress of the West Country. Over the last seven years the Board had so reinforced and extended its distribution system that from being a backward, undeveloped area electrically, the West Country was now in the van of electrical progress.

The growth in the industrial load was still outpacing the increase in the domestic demand, however, and to secure a better balanced load, and thereby keep down the price of electricity, it was essential to encourage the widest and most diverse use of the supply in the home. Keen salesmanship and really good service were an essential part of the Board's policy.

Ahead of Schedule

At the present rate of progress the Eastern Electricity Board's second five-year rural development programme may possibly be completed in about four years but if the Board finds that it can do more it will extend the scope of the programme. This information was given last week by Mr. G. N. Green, the Board's chief engineer, when he addressed members of the Eastern Electricity Consultative Council. As an indication of what had been achieved, he said that from the time when electricity supply commenced up to vesting day the number of farms connected in the area now served by the Board was just under 10,000. In the first seven years of the Board's operations a supply had been brought to 8,200 farms and by 1958 the total number served would be about 22,000—more than twice as many as in 1948. For the current year (1955-56) the Board had allocated approximately £1 million to new rural development work, compared with the £4¾ million spent in the first seven years. A supply would be brought to some 12,000 additional rural premises including 1,400 farms. Including reinforcement work and supplies to pumping stations, rural industries, etc., a total sum of about £1¾ million would be spent for the benefit of the rural communities.

Hire of Electric Cookers

In view of the recent restrictions on hire purchase the Eastern Electricity Consultative Council asked the Board to consider whether the arrangements for the simple hire of cookers, as opposed to hire purchase, should be extended. The Board, in a reply reported to the Council last Friday, said it had fully reviewed the position but felt that any extension of the Board's scheme of simple hire to cover new apparatus was not at present justified. It would, however, keep this matter under constant review.

Rural Supply Costs

At a recent meeting of the Blackawton (Devon) Parish Council a memorandum was unanimously adopted drawing attention to the urgent need for electricity in agriculture and the unlimited scope for progress in that direction. In view of the acceptance of the problem of uneconomic rural development as a national responsibility, the Council contends that the cost to the consumer should be the same in every area and all special charges should be basically similar. In particular it refers to the "onerous terms" of the South Western Board's rural development scheme which it considers places an unfair burden on the consumers in the area.

Erne Hydro-Electric Scheme

Shortly after the outbreak of the last war the Electricity Supply Board in Dublin developed a scheme for generating electricity from the Erne in Donegal, and to secure a flow of water from lower Lough Erne it offered to pay for the widening and deepening of the outfall channel from the lough, and for ancillary works. The fall in the river channel in Northern Ireland is so small that it would make hydro-electric development in Fermanagh out of the question. The Northern Ireland Ministry of Finance, acting as agent for the Electricity Supply Board, reports that the work of widening and deepening the outfall channel should be substantially completed about the end of September next. It is estimated that the works being carried out at the expense of the Electricity Supply Board will cost over £1,500,000 and that the relief drainage scheme will cost over £500,000.

Central African Board

Changes in the constitution of the Federation of Rhodesia and Nyasaland Hydro-Electric Board are announced. The chairman-designate is Mr. D. L. Anderson, at present controller of the Colonial Development Corporation in the Federation, Bechuanaland and Swaziland, who takes up duty on 24th May. Mr. K. C. Acutt, local director of the Anglo-American Corporation of South Africa, replaces Mr. J. H. Lascelles, resident director of the Rhodesian Selection Trust, who resigned when the Federal Government announced its intention of proceeding with the Kariba Gorge scheme in preference to that at Kafue. Other members of the Board include Mr. A. B. Cowen, chairman of the Electricity Supply Commission of Southern Rhodesia; Mr. H. W. Stevens, general manager of Nyasaland Railways; and Major H. K. McKee, former Northern Rhodesian Commissioner in London.

Ash Sluicing

South Shields Town Council has considered a report by consulting engineers on the possible effects of ash being sluiced from Blyth power station into the sea. The report stated that although there was no likelihood of immediate danger to South Shields beaches from the depositing of ash into the sea, the beaches might be affected in ten years' time. The Council has decided to continue its opposition, in conjunction with other local authorities, to the C.E.A.'s arrangements for disposing of ash.

Norway to Export Power

Norwegian and Swedish representatives have reached an agreement recently for the export by Norway of hydro-electric power from the Nea project. The Norwegian Government will not only be responsible for delivery of the power, but will also finance the necessary construction, estimated to cost about Kr.120 million. Norway will deliver 300 million kWh per annum to Stockholm over a period of 15 years.

Hire-Purchase in Australia

The New South Wales Cabinet recently approved legislation requiring a minimum deposit of 10 per cent on all hire-purchase transactions and making "no deposit" trading an offence. The Western Australian Government is making inquiries into hire-purchase business and may appoint a Royal Commission on the matter.

Financial Section

STOCKS and SHARES

SEVERAL important declarations of dividends, and other individual company news, have served to maintain animation here and there in the industrial markets of the Stock Exchange. Activity as a whole tends, however, to become increasingly curtailed by the approach of the General Election, and has not been improved by further recent weakness in the gilt-edged market. Under the influence of the tighter credit policy, Government securities have been at their lowest levels for some two years. Among industrial shares, Plessey are somewhat of a feature, with a 5s rise to 68s 9d, a little demand finding the market poorly supplied with shares. Tube Investments gained 7s 6d, at 82s 6d, upon the announcement of an increased dividend.

A.E.I. New Shares

After drifting back to 24s 9d, the premium on the new £1 ordinary shares issued at 40s by Associated Electrical Industries picked up to 27s. Selling of the "rights" to the offer, which is made to existing stockholders and involves more than £10 million new money, appeared to be well balanced by investment glad of the opportunity to buy the shares in allotment letter form, and, therefore, free of the 2 per cent transfer stamp duty. Payment for shares accepted is not due until 3rd June, about a week after the General Election. They do not entitle holders to the first of the quarterly dividends, due in July, which the company is inaugurating this year.

C. A. Parsons Prospects

Full accounts available now from C. A. Parsons & Co. confirm that with the net profit up to £1,484,000 (after tax of over £1½ million) the modestly increased dividend of 10 per cent involves the distribution of no more than one-seventh of the available surplus. This heavy earnings "cover" is accepted as one of the factors responsible for the persistent quotation of the shares on a yield basis of only about 3 per cent. Another is, of course, the great programme of further expansion, as outlined by Sir Claude Gibb in his accompanying statement, in which he discloses some details of the part being played by the firm in nuclear power projects. Despite his advice that financial requirements for several years ahead might make essential a standstill in dividend payments, the price of the shares rose by 5s to 70s ex dividend.

T.C. & M. Capital

The Telegraph Construction & Maintenance Co. has reported net group earnings for 1954 (after tax) at about the level of the previous year, and no change in the ordinary distribution at 8½ per cent (including a bonus of 1 per cent). In his review accompanying the full accounts, the

The Week's Price Changes

Company or Board	Nom. Value	Middle price 9th May	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1955 Highest	1955 Lowest
Gilt-edged Stocks						£ s d		
Brit. Elec. 1968/73	100	85½	−1	3	3	3 10 3	94¼	85½
Brit. Elec. 1974/77	100	84½	−1	3	3	3 11 0	93⅞	84½
Brit. Elec. 1976/79	100	89½	−1	3½	3½	3 18 3	98¾	89½
Brit. Elec. 1974/79	100	100½	−1	4½	4½	4 4 6	109	100½
Overseas Electric Supply								
Calcutta Elec.	£1	22/-		6†	6†	5 9 0†	22/6	20/9
East African Power	£1	21/6		7	7	6 10 3	23/3	19/9
Nigerian Elec.	£1	24/-	+6d	10	10	8 6 8	27/-	22/6
Palestine Elec. "A"	£1	21/-		Nil	Nil	—	22/9	21/-
Perak Hydro-Elec.	£1	18/-		6	10	11 2 3	21/-	17/9
Equipment and Manufacturing								
Aberdare Cables	5/-	12/9		12½	17½	6 17 3	13/9	11/-
Aerialite	1/-	6/3x.d.		88½	88½	—	6/7	5/3
Allen, W. H.	£1	79/6		15	20	5 0 8	81/6	78/6
Aron Elec. Ord.	£1	61/3	+1/9	20	15	4 18 0	62/-	55/6
Assoc. Elec. Ord.	£1	66/3		—	14	—	—	—
Automatic Tel. & El.	£1	72/-		15	15	4 3 4	79/6	69/-
Babcock & Wilcox	£1	73/9x.d.		12*	15	4 1 3	81/6	68/6
Baldwin, H. J.	2/-	4/9		20	20	8 8 6	5/4	4/4
Bakelite	10/-	28/9		12½	16	5 11 6	32/-	27/-
British Aluminium	£1	42/-	+2/-	10	12	5 10 4	43/9	35/3
B.I. Callender's	£1	46/-x.d.		10	10	4 7 0	55/3	44/9
B.I. Callender's 6% Pref.	£1	25/-		6	6	4 16 0	26/6	24/-
British Thermostat	5/-	23/9		35	27½*	—	27/3	22/6
British Vac. Cleaner	5/-	16/6	+6d	25	30	9 1 10	17/9	14/3
Brook Motors	10/-	41/3		20	20*	—	42/9	39/9
Brush Ord.	5/-	8/-x.d.		6	10	6 5 0	9/6	7/7
Bulgin, A. F.	1/-	5/-		30	45	9 0 0	5/3	4/-
Burco	5/-	18/9		35	25*	6 13 3	23/-	18/9
Chloride El. Storage "A"	£1	68/9x.d.		12½	17½	5 1 9	70/-	58/6
Clarke Chapman	£1	82/6		20	20*	4 17 0	84/-	68/9
Cole, E. K.	5/-	19/6		25	27½	3 10 6*	24/6	18/3
Cossor, A. C.	5/-	9/-		10	10	5 11 1	11/3	8/9
Crabtree	10/-	30/9		17½	20	6 10 0	34/6	29/3
Crompton Parkinson Ord.	5/-	16/9		20	20	—	19/9	16/-
De La Rue	5/-	21/9		Nil	20	4 11 11	24/3	18/9
Decca	4/-	34/6		35	56½*	—	45/6	31/-
Desoutter	5/-	27/9		20	25	4 10 1	28/-	25/6
Dewhurst	2/-	8/-		19	24	6 0 0	8/3	7/3
Dictograph Tel.	2/-	7/-		20	20	5 14 3	7/6	6/6
Dubilier Condenser	1/-	5/-		25	25	—	5/7	3/10
E.M.I.	10/-	28/-	−9d	8	10	3 11 6	37/-	25/3
Electrical Components	5/-	15/9		20	20	6 7 0	17/6	15/3
Elec. Construction	£1	33/9		15	15	4 9 0*	37/3	31/6
Enfield Cable Ord.	£1	20/-		Nil	Nil	Nil	25/3	20/-
English Electric	£1	63/9		10	12½	3 18 6	69/3	54/3
English Electric 3½% Pref.	£1	15/6		3½	3½	4 16 9	16/9	14/9
Ericsson Tel.	5/-	38,-		25†	20†*	2 12 9	38/-	29/-
Ever Ready	5/-	27/-x.d.		40	35*	6 9 9	28/9	22/3
Falk Stadelmann	£1	46/3		15	15	6 9 9	50/6	43/9
G.E.C. Ord.	£1	56/3		11½	12½	4 9 0	61/9	51/3
G.E.C. 6½% Pref.	£1	27/-		6½	6½	4 16 3	28/4	23/6
General Cables	5/-	15/9		30	30	9 10 6	17/-	15/9
Greenwood & Batley	£1	55/-		17½	17½	6 7 3	57/-	54/6
Hackbridge Cable	5/-	17/3	+6d	20	20	5 16 0	17/9	14/-
Hackbridge & Hewittic	5/-	24/6		20	25	5 2 0	28/9	23/9
Hall Tel. Acc.	10/-	13/3		10	10	7 11 0	13/9	11/-
Heatrae	2/-	4/6		12½	12½	5 11 0	5/9	4/3
Henley's	10/-	18/-x.d.		10½	10½	5 16 9	20/6	17/-
Holophane	5/-	17/6		20	25	7 2 9	19/9	16/-

* After scrip issue. † Free of income tax.

The above quotations are based upon middle prices in the Stock Exchange Daily Official List.

chairman states that after a slow start in some sections, the year ended with order books much larger than they were at the start. He says that there may be a further share issue if the company is successful in completing current negotiations for the acquisition of another business.

Aerialite Issue

Following the declaration of a 17½ per cent interim dividend on account of the year ended last March, Aerialite have announced the intention of raising some £200,000 new capital by an issue of shares, and of recommending a final dividend of not less than 26½ per cent on the capital so increased. Shareholders are to be offered one new 1s share at 4s for every three existing shares held. Since last year the ordinary capital has been doubled, to £150,000, by a scrip issue. A total dividend of 44 per cent would therefore be equal roughly to the rate of 88½ per cent paid in recent years on the smaller amount. On that basis, and estimating an allowance for the value of the "rights," the shares may be regarded as offering a prospective yield of around 7¾ per cent. The shares have been changing hands at a trifle above the official quotation of 6s 3d x.d.

in Electrical Investments

Company or Board	Nom. Value	Middle price 9th May	Week's Rise or Fall	Dividend Previous	Dividend Last	Yield %	1955 Highest	1955 Lowest
Equipment and Manufacturing—continued.						£ s d		
Hoover	5/-	47/-	+1/-	45	70	7 8 10	52/6	40/-
I.C.I.	£1	42/3x.d.		15	10°	4 14 9	45/3	38/3
Intl. Combustion	5/-	27/-		20	25	4 12 6	30/6	23/6
Johnson & Phillips	£1	45/-x.d.		15	15	6 13 4	52/6	45/-
Lancashire Dynamo	£1	61/3		14	15	4 18 0	62/6	55/3
Laurence, Scott	5/-	15/6x.d.		20	12½°	4 0 9	16/9	14/6
Lister, R. A.	£1	33/6		12	9·3°	5 11 3	38/3	30/6
London Elec. Wire	£1	51/6x.d.		10	12½	4 17 0	61/-	50/6
Lucas, J.	£1	43/-	+6d	10·8	7½°	3 9 9	50/6	41/6
Marryat & Scott	2/-	9/6		22½	25	5 5 3	10/4	9/6
Mather & Platt	£1	62/-		15	13·4°	4 6 6	63/-	48/-
Metal Industries	£1	34/-	+6d	12	9	5 6 0	38/-	30/-
Midland Elec. Mfg.	£1	46/3		15	10°	4 6 6	46/6	44/-
Morphy-Richards	4/-	27/-		40	35°	5 3 9	31/9	27/-
Murex	£1	53/9	−9d	15	15	5 11 6	57/-	49/3
Newman Ind.	2/-	2/9		10	10	—	3/6	2/4
Oldham & Son	1/-	3/6		17½	17½	5 0 0	3/6	2/10
Parnall (Yate)	5/-	10/9	−3d	8	14	6 10 3	13/2	7/3
Parsons, C. A.	£1	70/-x.d.	+5/-	7½	10	2 17 3	70/-	56/-
Plessey	10/-	68/9	+5/-	30	20°	2 18 0	76/6	57/6
Pye Deferred	5/-	32/6		20	20°	2 19 3	40/6	28/6
Revo	10/-	13/-		27½	9°	6 18 6	15/3	12/6
Reyrolle	£1	92/6		13¾	15	3 4 9	106/3	89/-
Rheostatic	4/-	17/6		20	22½	5 2 9	17/6	14/9
Richardsons Westgarth	5/-	13/9		15	15°	5 9 0	15/-	11/-
Scottish Cables	4/-	19/9	−6d	20	27½	5 11 3	22/6	19/6
Smith (England), S.	4/-	16/3	−3d	15	17½°	4 6 3	20/-	15/-
Southern Areas	£1	31/3		6	7½	4 16 0	34/9	27/6
Strand Elec.	5/-	9/3	−6d	17½	17½	8 19 6	9/9	8/6
Sturtevant	5/-	27/6x.d.	+2/6	18·9	14·4†°	2 13 6†	27/6	21/-
Sun. Elec.	£1	33/9		15	15	8 17 9	34/6	33/9
Switchgear & Cowans	5/-	15/-		10	20	6 13 4	15/6	11/-
Taylor Tunnicliff	5/-	13/3		12½	15	5 13 3	14/-	11/3
T.C.C.	10/-	47/6		30	25°	5 5 3	48/-	41/-
T.C. & M.	£1	36/-x.d.		8½	8½	4 14 6	40/9	35/-
Telephone Mfg.	5/-	9/6		10	10	5 5 3	10/6	9/3
Thorn Elec.	5/-	35/6		12½	20	2 16 3	37/6	26/3
Thornycroft	£1	40/-		15	15	—	44/-	34/6
Tube Investments	£1	82/6	+7/6	15	17½	4 4 9	85/9	72/6
Vactric	5/-	13/9		Nil	10	—	18/9	12/-
Veritys	5/-	7/-x.d.		12½	12½	8 18 6	9/3	7/-
Walsall Conduits	4/-	50/-		70	70	5 12 0	55/-	50/-
Ward & Goldstone	5/-	38/9		45	50	—	43/3	37/6
Watford	2/-	7/3x.d.		22½	25	6 18 0	7/3	6/3
Westinghouse Brake	£1	98/9	+1/3	16	18	3 13 0	101/9	82/-
West, Allen	5/-	14/-		17½	15°	5 7 3	15/6	8/-
Wolf Electric	5/-	18/3		17½	20	5 9 6	19/3	16/1
Trusts, Transport and Communications								
Anglo-Am Tel.:								
A. Ord.	100	75½x.d.		6	6	7 19 0	88	75½
Ord.	100	50x.d.		3¾	3¾	7 17 6	54½	50/-
Anglo-Portuguese	£1	24/6		8	8	6 10 9	25/-	21/-
Brit. Elec. Traction:								
Def. Ord.	5/-	21/-		35	50	—	24/3	19/6
Cable & Wireless:								
Ord.	£1	43/9		9	10	4 11 6	48/9	39/6
4% Loan	100	97½		4	4	4 2 0	100/-	92/-
Calcutta Trams	£1	23/6	−1/6	2½†	6†	5 2 2†	25/-	20/-
Cape Elec. Trams	£1	17/6		5½	7½	8 0 0	17/6	16/6
Marconi Marine	£1	37/-		10	10	5 8 0	37/6	33/-
Oriental Tel. Ord.	£1	100/-	+1/3	16	16	—	102/6	96/6
Telephone Props.	£1	85/-	+2/6	—	20	4 14 3	90/6	80/6
Telephone Rentals	5/-	12/-	+6d	10	12½	5 4 3	12/-	9/6

Decca Interim

Decca Record's dividends on account of the twelve months ended in March will be payable on ordinary capital enlarged since last year from £560,000 to £1,051,000 as a result of the cash and capitalization issues. In declaring, therefore, an interim dividend of 3d per share, which is the same as the corresponding payment in 1954, the directors warn shareholders that this does not necessarily imply that the total for the year will also be maintained at the previous level. It can be calculated that in terms of cash this would involve an increase in the net amount distributed from £173,000 to over £330,000.

Company News

The market was agreeably surprised by the news of an increased interim dividend from Tube Investments, on account of the financial year ending next July. With this payment raised from 7½ to 10 per cent, which is at the same rate as last year's final, the market feels it safe to assume a total of 20 per cent, and perhaps a fraction more, for the year. The price of the shares was marked up by 7s 6d to 82s 6d. Atlas Electric Trust rose 1s to 28s 9d after the report of increased earnings and a rise in the dividend to 6½ per cent. Telephone Rentals also improved, to 12s, on the strength of the higher dividend of 12½ per cent.

Coming Dividends

Of the companies which end their financial years with the calendar, most have now announced their final dividends and results, but several interesting declarations due about now include those from the Southern Areas and Telephone Manufacturing companies. The former's shares, quoted recently around 31s 3d, have travelled a long way since this time last year, when the single distribution for the year was raised from 6 to 7½ per cent and the shares were standing at under 20s. Telephone Manufacturing have been paying annual totals of 10 per cent for several years.

REPORTS and DIVIDENDS

The Telegraph Construction & Maintenance Co., Ltd.—The consolidated trading profit for 1954 is £464,611, as compared with £485,047 for 1953, which with income from other sources, makes a total of £596,430 (against £618,802). After meeting all charges, including £150,577 for taxation, the net balance is £223,897 (£223,337). The balance available to the parent company is £216,155 (£220,972). Reserves receive £105,000 and it is proposed to pay a final ordinary dividend of 3¾ per cent, making 7½ per cent for the year (unchanged). It is also again proposed to pay a cash bonus on the ordinary shares of 1 per cent. The balance carried forward is £105,993 (against £95,124 brought in).

In his statement which accompanies the report and accounts, Mr. J. N. Dean (chairman and chief executive) says that in the early part of the year under review orders came in very slowly for the cables division, particularly so far as power cables were concerned, but in the latter part there was a substantial improvement, and they ended the year with an order book, in each division, substantially larger than in the opening period. The year was a period of unprecedented activity in the engineering division, for not only has the expansion of the cables division been proceeding, and the new plastics division at Farnborough been set up on a wider basis, but the Transatlantic telephone cable project, mentioned last year, has been transformed into a first-class engineering reality. The cable ship *Monarch* has had major alterations and additions carried out to her gear to enable her to lay flexible repeaters for the Atlantic cable, and the *Ocean Layer*, the Submarine Cable Co.'s new ship, has made a heavy call upon their engineers for the design and manufacture of a vast amount of intricate cable-laying equipment.

The transfer of the metals division to Crawley is nearing completion and production has already started there. The expansion of the plastics division continues and the polythene powder section is particularly busy. Several new products have been produced by the cables division and these are being favourably received both at home and overseas. The research division has widened its scope to unite again all technical and research matters. Each of the subsidiary companies and associate companies has had a profitable year. Rubber planting at the Selborne Estates is carrying on steadily, and at the same time gutta percha output continues profitably, and is keeping pace with sales. The new South African factory in Wadeville, Germiston, was opened in March last year, and during the year it was decided to increase their shareholding in the associate company in Australia, A.W.A. Telcon Pty., Ltd., which will enable the factory to be enlarged and moved to a new site near Sydney.

Submarine Cables, Ltd., jointly owned with Siemens Brothers & Co., Ltd., has had an active year, during which the plant at Erith has been set up and put into operation to manufacture the Transatlantic telephone cable. The installation of the new factory has involved Submarine Cables, Ltd., in heavy capital expenditure, and in addition that company has embarked upon the provision of an up-to-date cable-laying ship. On completion of the Transatlantic telephone cable contract substantial additional capital assets will have been acquired, many of which have been provided out of accumulated reserves from past trading. Negotiations are proceeding for the purchase of a privately owned company engaged in the manufacture of products closely allied to their own, with substantial assets and good earning prospects. If these negotiations are successfully concluded it will involve a substantial expenditure which, in addition to the submarine cable developments, may make it necessary to consider an issue of shares.

C. A. Parsons & Co., Ltd.—A preliminary statement of the financial results for 1954 was published in our issue of 22nd April. The report and accounts now issued show a trading profit of £3,033,162, as compared with £2,379,016 for 1953, and after deducting £1,542,250 for taxation, the net balance is £1,484,299 (against £807,862). General reserve receives £1,100,000 and as already announced, the final ordinary dividend is 6¼ per cent, making 10 per cent for the year on capital trebled by a 100 per cent scrip issue and a 100 per cent rights issue. For 1953 an interim dividend of 6¼ per cent was paid before the capital issues and a final dividend of 4⅜ per cent on the present capital. The balance carried forward is £297,692 (against £124,593 brought in).

In his circulated statement, Sir Claude Gibb (chairman and managing director) says that during the year under review output again was a record. The new heavy erecting and testing bay was completed during the year and an extension of the alternator bay will be completed during the present year. The ever growing size of turbo-generators now is such that wider, higher and heavier bays with much greater floor space are required to cope with present and future orders. These can only be provided on land to the south of Shields Road which was leased from the Newcastle Corporation in 1953. The size and weight of component parts which then would have to cross Shields Road for machining and subsequent return for assembly, etc., would be such as to make road transport a danger. Only by rail access could the future demands be met with efficiency and safety. Application has been made to the Minister of Transport and Civil Aviation for an Order to construct a railway connecting the north and south section of the Heaton Works, and should that Order be made plans will be put in hand to build new shops covering over 300,000 sq ft and to equip these at a cost exceeding £3,000,000. Sir Claude then refers to the proposed establishment of a separate Corporation for the design and construction of nuclear power plants, reference to which is made elsewhere in this issue.

After reference to the opening of the factory of the Australian company at Whyalla, South Australia, in September last, Sir Claude mentions that Sir Howard Grubb Parsons & Co., the optical division, which has hitherto been operated as a separate company, is to become a wholly owned subsidiary company with an authorized capital of £500,000.

Veritys, Ltd.—In connection with the accounts for 1954 published in our issue of 29th April, we are asked to state that the total dividend for the year is 12½ per cent, and no bonus is paid. For 1953 the distribution was also 12½ per cent, but this included a bonus of 2½ per cent. The amount set aside in the 1954 accounts for general reserve is £13,050 and not £3,050 as stated.

The Atlas Electric & General Trust, Ltd., reports a net revenue for the year to 31st March last, after providing £357,718 for taxation, of £395,936, as compared with £339,003 for 1953-54. It is proposed to pay a dividend of 6½ per cent on the ordinary capital as increased by a two-for-five free scrip issue last January. For the previous year the dividend was 7 per cent on the smaller capital.

Wm. Sanders & Co. (Wednesbury), Ltd.—The accounts for 1954 show a trading profit of £36,232, as compared with £26,024 for 1953. After meeting all charges, including £16,166 for taxation, the net profit is £13,767 (against £7,096). Reserves receive £4,200 and it is proposed to pay a dividend for the year of 20 per cent (against 15 per cent) and to carry forward £26,959 (against £26,017 brought in).

The British Vacuum Cleaner & Engineering Co., Ltd.—The directors recommend an issue, by way of capitalization of reserves, of 600,000 ordinary shares of 5s each credited as fully paid up to the holders of the existing 600,000 ordinary shares in the proportion of one new ordinary share for each ordinary share held, ranking for the full amount of all dividends declared in respect of the current

(*Continued on page* 853)

Reports and Dividends (*continued*)

financial year. Application is being made to the Capital Issues Committee for consent to the issue.

Enfield Cables, Ltd.—The main figures in the accounts for 1954 were given in our last issue. In his statement which is issued with the report and accounts Sir Philip Warter (chairman) says that the main reason for the unsatisfactory result for the year under review was a substantial decrease in turnover, especially in export business. A considerable loss was incurred in the Contracts Department and steps have been taken to overhaul this department. Efforts during 1954 have been concentrated on the reorganization of the cable business. Mr. M. J. Smith, technical director, has planned the work of the Technical Department under three main heads: first, to fill the gaps in the range of cables so that they can compete in any profitable field; second, to maintain and improve the quality of the products; third, to reduce the costs of production. Improvements have been made in the compression type of high voltage cable which has been the mainstay of the company's activities in this field. Other types of high voltage cables are also being developed. Work has been done on special types of paper-insulated cables, on the use of plastic insulation, and on the use of aluminium instead of copper. Particular attention has been paid to improving corrosion-protective coverings. During the year moulded plugs and sockets have been developed. A new technical laboratory is being planned to provide testing facilities for high voltage cables.

During the year £100,000 was spent on new plant and equipment. The plant for the manufacture of covered conductors was moved at the end of the year from Blaenavon to Brimsdown, which should result in increased efficiency and lower costs. A range of transformer cable boxes has been developed at the Tottenham factory, complying with the new C.E.A. standard specifications. Production started in September and sales have been encouraging.

In considering the prospects for the current year there should be taken into account the uncertainty arising from the supply position and price fluctuations of copper, and also the radical changes in the commercial structure of the industry brought about by the decision of the C.M.A. and the Covered Conductors Association to accede to the request of the Government to implement the recommendations of the Monopolies Commission. Available figures and forecasts indicate a modest profit.

Aerialite, Ltd., has announced an interim dividend of 17½ per cent (against 33⅓ per cent) on doubled capital. The directors announce a rights issue of one new 1s ordinary share at 4s for every three 1s ordinary shares held. The issue will raise £200,000 of new money. The new shares will participate in the final dividend for the year to 31st May next, which, the board expects, will not be less than 26½ per cent.

Telephone Rentals, Ltd.—The group profit for 1954, before taxation, is £707,614, as compared with £686,949 for the preceding year. Taxation absorbs £358,324 and the net balance is £349,290 (against £219,841), of which £344,704 is attributable to the parent company. It is proposed to pay a final dividend of 8½ per cent on the ordinary shares (against 6 per cent), making 12½ per cent for the year on ordinary capital of £1,760,000. For 1953 the total distribution on £1,600,000 capital was 10 per cent.

G. N. Haden & Co., Ltd.—A group trading profit of £231,492 is announced for 1954. This compares with £228,903 for 1953. Taxation requires £129,514 and it is proposed to pay an ordinary dividend for the year of 20 per cent (against 15 per cent).

The Radio & Television Trust, Ltd., announces that negotiations are taking place as a result of which the directors expect shortly to receive a cash offer for the whole of the 6 per cent cumulative redeemable preference stock and 6 per cent sinking fund certificates. A further communication will be made to stockholders as soon as possible.

Tube Investments, Ltd., has declared an interim dividend of 10 per cent (against 7½ per cent).

Holophane, Ltd., is paying an interim dividend of 7½ per cent (unchanged).

New Companies

Antess, Ltd.—Registered 20th April. Capital £500. Electrical engineers, etc. Directors: R. H. Tomkins and Mrs. Sheila T. Tomkins. Regd. office: Vicarage Place, Walsall.

Griffin Radio, Ltd.—Registered 19th April. Capital £1,000. To acquire the business of a radio and television retailer, manufacturer, electrical engineer, repairer and contractor carried on by F. B. Griffin, etc. Directors: F. B. Griffin and Mrs. Diana M. Griffin. Regd. office: 122, Bristol Street, Birmingham.

Electro (Wednesbury), Ltd.—Registered 23rd April. Capital £1,000. Electrical and electronic engineers and contractors, etc. Directors: Mrs. Edith L. Pugh, A. S. Pugh, S. Turner and M. J. Fowell. Regd. office: 79, Holyhead Road, Wednesbury, Staffs.

A. K. Waugh, Ltd.—Registered in Edinburgh 24th March. Capital £10,000. Electrical engineers, manufacturers of electrical immersion heaters, line heaters, etc. The first directors are not named. Regd. office: 218, Holm Street, Glasgow, C.2.

Field & Grant, Ltd.—Registered 7th April. Capital £15,000. To acquire the business of manufacturing electrical engineers and technical sales agents now carried on by P. L. Field and C. E. Grant at 68-71, Kent Street, Birmingham, as "Field & Grant." Directors: P. L. Field, Cecilia M. Field, C. E. Grant and Olive R. Grant. Solicitors: Glaisyer, Porter & Mason, Birmingham.

A. R. Shepherd & Son, Ltd.—Registered 25th April. Capital £1,000. To acquire the business of radio, television and electrical service engineers now carried on at 364, Brockley Road, S.E.4, as "A. R. Shepherd." Directors: A. R. Shepherd and Mrs. Kathleen Shepherd. Regd. office: 364, Brockley Road, S.E.4.

T.I.E. (Installations), Ltd.—Registered 27th April. Capital £100. To install, develop and operate radio and television relay equipment and to carry on the business of radio, television, telephonic and telegraphic engineers, etc. Directors: D. R. Lewis and M. H. Bolderson. Regd. office: Aerial House, Tylagwyn, Nantgarw, Glam.

Increases of Capital

Belmos Co., Ltd.—Increased by £400,000, in 150,000 6½ per cent cumulative preference and 250,000 ordinary shares of £1, beyond the registered capital of £100,000.

Electric & Musical Industries, Ltd.—Increased by £2,500,000, in £1 5½ per cent cumulative 2nd preference shares, beyond the registered capital of £6,266,000.

TRADE MARKS

APPLICATIONS have been made for the registration of the following trade marks. Objections may be entered up to 27th May:—

No. 720,401 (design), Class 7. Electric motors (not for land vehicles), condensing installations, condensers, compressors, regulators (being parts of machines), ignition devices for engines and motors; laundry machines; food preparing machines, etc.; polishing machines, carpet sweeping and scrubbing machines; machines for waxing and oiling floors; machines for shampooing carpets and rugs, etc., all being electrically operated and none being for domestic use; and parts.—Junkers & Co., G.m.b.H., Wernau-am-Neckar, Germany. Address for service, c/o Abel & Imray, Quality House, Quality Court, Chancery Lane, London, W.C.2.

STATOSTRAP. No. 737,744, Class 9. Conducting devices for earthing the static electricity in motor land vehicle bodies.—W. B. Jellett, Quadrex House, Park Lane, London, W.1.

DIEHL. No. B738,411, Class 9. Electric switches, rheostats, transmitters, transformers, switch boxes, capacitor boxes, vacuum cleaners and parts. DIEHL. No. B738,412, Class 11. Electric fans, lamp sockets, lighting fittings, and lighting installations.—Diehl Manufacturing Co., Bridgewater Township, N.J., U.S.A. Address for service, c/o Cruickshank & Fairweather, 29, St. Vincent Place, Glasgow, C.1.

KLORIDEX. No. 739,268, Class 9. Electric accumulators.—Chloride Electrical Storage Co., Ltd., Exide Works, Clifton Junction, near Manchester.

INDUSTRALUX. No. 736,576. LOUVERLUX. No. 736,577. TUBALUX. No. 736,578. All Class 11. Electric lighting fittings and parts.—Troughton & Young (Lighting), Ltd., 143, Knightsbridge, London, S.W.1.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 0d each including postage) will be obtainable after 15th June from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1950

6906. Postmaster General.—Electronic switching systems. 20th March, 1950. (731912.)

12533. British Telecommunications Research, Ltd.—Modulators for electric oscillations. 19th April, 1951. (731913.)

20788. Marconi's Wireless Telegraph Co., Ltd.—Inter-stage couplings for television and the like systems. 30th May, 1951. (731662.)

28683. Murphy Radio, Ltd.—Television receivers. 25th February, 1952. (731916.)

1951

11151. British Thomson-Houston Co., Ltd.—Method of and apparatus for mechanically converting electric currents. 30th April, 1952. (731919.)

12230. Staatsbedrijf der Posterijen, Telegrafie en Telefonia.—Automatic volume regulator. 24th May, 1951. (731669.)

12511. Siemens & Halske Akt.-Ges.—Semi-conductors. 28th May, 1951. (732045.)

27537. English Electric Co., Ltd.—Electric motor control systems of the Ward-Leonard type. 23rd February, 1953. (731809.)

28349. Licentia Patent-Verwaltungs-Ges.—Apparatus for the regulation of rotation speed or torque of direct current motors. 3rd December, 1951. (731928.)

29468. Standard Telephones & Cables, Ltd.—Electrical equipment for handling individual demands for attention from a number of circuits. 16th January, 1953. (731811.)

29483. Hotpoint Electric Appliance Co., Ltd.—Sheathed electrical heating elements. 30th September, 1952. (731666.)

1952

3502. National Research Development Corporation.—Electric pulse generators for coaxial lines. 23rd January, 1953. Cognate application 11265, 5th May, 1952. (731668.)

4844. Electro Methods, Ltd., and Baracz, A. J.—Electric control arrangements for regulating an electric alternator. 4th February, 1953. (731670.)

7008. Landis & Gyr, Ltd.—Differential electrical switching apparatus. 16th March, 1953. (731675.)

7417. N.S.F., Ltd.—Piezo-electric microphones. 20th March, 1953. (731676.)

8005. British Thomson-Houston Co., Ltd.—Luminescent materials. 20th February, 1953. (731677.)

8060. Hollander, J. M.—Electromagnetic switches. 13th March, 1953. Cognate application 15057, 16th June, 1952. (731931.)

10358. Rotol, Ltd.—Load-share responsive devices for paralleled systems of three-phase alternators. 20th April, 1953. (732052.)

11603. Electric & Musical Industries, Ltd.—Protection circuits for cathode ray tubes. 24th April, 1953. (731679.)

11658. British Thomson-Houston Co., Ltd.—Protection of electric current transformers. 7th May, 1953. (732054.)

12774. Telefonaktiebolaget L. M. Ericsson.—Devices for automatic level regulation in multi-channel carrier frequency line transmission systems. 21st May, 1952. (731680.)

13720. Telephone Manufacturing Co., Ltd., and Carpenter, R. E. H.—Electromagnetic relays. 13th May, 1953. (731937.)

15801. F.K.G.F. Kesselring Geratebau Akt.-Ges.—Electromagnetic switches. 23rd June, 1952. (731685.)

16403. Edison Swan Electric Co., Ltd., and Ansell, K. W.—Spot lights. 24th September, 1953. (732057.)

16961. Crabtree & Co., Ltd., J. A., Wintle, T. D. G., and Hill, W. E.—Operating members for emergency stop switches for electrical apparatus. 30th June, 1953. (731687.)

19010. Air Reduction Co., Inc.—A.c. inert gas shielded arc welding. 28th July, 1952. (731836.)

22076. Vickers-Armstrongs, Ltd., and Metropolitan-Vickers Electrical Co., Ltd.—Follow-up remote control systems. 17th August, 1953. (731842.)

23972. Philips Electrical Industries, Ltd.—High frequency generators for dielectric heating. 24th September, 1952. (731950.)

24593. Philips Electrical Industries, Ltd.—Colour television receivers. 1st October, 1952. (731695.)

24769. Lloyd, J. W.—Adaptor for use with electric lights. 5th October, 1953. (731697.)

24882. General Electric Co., Ltd., and Nelson, E. H.—Electric discharge lamps. 16th September, 1953. (731694.)

26371. English Electric Co., Ltd.—Electrical induction relays. 20th October, 1953. (732075.)

26557. General Electric Co., Ltd., and Lee, F.—Electric transformers and like apparatus. 19th October, 1953. (731957.)

26764. General Electric Co., Ltd., and Williams, C. E.—Arrangements for producing light by electroluminescence. 17th September, 1953. (731959.)

27786. General Electric Co., Ltd., Ayres, J. L., and Walsh, A. S.—Electromagnetic waveguide systems. 21st October, 1953. (732076.)

30665. Licentia Patent-Verwaltungs-Ges.—Electric switch or contactor with resiliently supported contacts. 3rd December, 1952. (731713.)

30883. Huntley & Palmers, Ltd.—Protective safety device including an electric switch controlled by a guard for electrically driven machinery. 4th December, 1953. (731714.)

30939. General Electric Co., Ltd.—Apparatus for translating electric signals from one band of frequencies to another. 5th March, 1954. (731715.)

31081. Dowty Equipment, Ltd.—Electrically operated indicating instruments. 27th November, 1953. (731967.)

31109. British Insulated Callender's Cables, Ltd.—System of distribution by wire of high frequency currents. 7th December, 1953. (731716.)

32252. General Electric Co.—Automatic controls for defrosting refrigerator evaporators. 19th December, 1952. (731970.)

1953

1655. Edison Swan Electric Co., Ltd.—Processes for coating surfaces. 11th January, 1954. (731974.)

1939. National Research Development Corporation.—Electric batteries. 12th January, 1954. (731729.)

2548. Lucas (Industries), Ltd., J.—Electric lamps. 20th January, 1954. (731731.)

2652. Prince, D. C.—Cooling of dynamo-electric machinery. 29th January, 1953. (731732.)

2742. Standard Telephones & Cables, Ltd.—Waveguide systems utilizing the Faraday effect. 30th January, 1953. (731734.)

3516. Cole, Ltd., E. K., and Levi, J. E.—Magnetic focusing devices for cathode-ray tubes. 8th February, 1954. (731978.)

3549. British Timken, Ltd.—Bearing mountings for the suspension of traction motors of electrically driven vehicles. 10th December, 1953. (731979.)

3813. National Research Development Corporation.—Electrical digital computing engines. 29th January, 1954. (731733.)

4208. Telefunken Ges. für Drahtlose Telegraphie Ges.—Television receivers. 16th February, 1953. (731980.)

4971. Pittsburgh Plate Glass Co.—Electric heating panels. 23rd February, 1953. (731985.)

6760. Siemens & Halske Akt.-Ges.—Supervisory arrangement for telecommunications switching systems. 11th March, 1953. (731862.)

6997. Radio-Industrie.—Supplies for television cameras. 13th March, 1953. (731989.)

11717. General Electric Co.—Panels for thermal insulation. 28th April, 1953. (731752.)

12019. Murphy Radio, Ltd.—Apparatus for testing by ultrasonic waves. 30th April, 1954. (732083.)

12517. Trist & Co., Ltd., R.—Photo-electric cells. 5th May, 1954. (731755.)

13231. Philips Electrical Industries, Ltd.—High frequency circuits for use in dielectric heating devices. 12th May, 1953. (732003.)

13798. Ebauches Soc. Anon.—Apparatus for producing periodic electric pulses. 18th May, 1953. (731878.)

14606. Record Electrical Co., Ltd.—Construction of electrical instruments. 25th May, 1954. (731760.) 14607. Moving coil electrical indicating instruments. 25th May, 1954. (731761.)

17285. Soc. l'Air Liquide, Soc. Anon. pour l'Etude et l'Exploitation des Procedés G. Claude.—Electric arc welding torch with a liquid cooled non-consuming electrode. 22nd June, 1953. (731890.)

17369. Haussauer, L. P.—Electric water heaters. 24th March, 1954. (731769.)

17401. Metropolitan-Vickers Electrical Co., Ltd.—Electric heating devices. 10th May, 1954. (731770.)

20461. International Business Machines Corporation.—Electrical digital data storage apparatus. 23rd July, 1953. (732018.)

21533. General Electric Co.—Electric rectifiers. 4th August, 1953. (732021.)

21747. Wilson & Batkin Pty., Ltd.—Electrically heated clothes horse. 6th August, 1953. (732022.)

23102. Licentia Patent-Verwaltungs Ges.—Electrostatic high voltage generator. 21st August, 1953. (731774.)

23898. Siemens & Halske Akt.-Ges.—High frequency multi-layer conductor. 28th August, 1953. (732024.)

24853. Mallory Metallurgical Products, Ltd.—Production of high density metal bodies such as electrical contact bodies. 8th September, 1953. (732029.)

26448. Standard Telephones & Cables, Ltd.—Multi-group primary-secondary-spread crossbar telephone system. 25th September, 1953. (731779.)

28146. Davidson, T. A.—Electrical pin-and-socket couplings. 13th October, 1953. (732027.)

28395. Svenska Relafabriken Aktiebolag.—Intercommunication systems. 14th October, 1953. (732028.)

29080. General Electric Co.—Methods of and apparatus for measuring the content of water and other impurities in insulating liquids. 21st October, 1953. (732093.)

29231. General Electric Co.—Luminescent materials. 22nd October, 1953. (731784.)

32965. Faber, E., and Hahn, L. (trading as Mauz & Pfeiffer).—Electrically driven mixing and stirring machine for kitchen use. 27th November, 1953. (731786.)

34601. Kohlhagen, W.—Synchronous motor of the self starting type. 11th December, 1953. (732039.)

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Australia.—20th June. Electricity Commission of New South Wales, Sydney. Ninety-one 33 kV outdoor circuit-breakers and current transformers. (E.S.B. 9517/55. Ten/13684.)* Steam generating plant. (E.S.B. 8849/55. Ten/13602.)* 27th June. Two 60 MW turbo-alternator sets. (E.S.B. 8850/55. Ten/13603.)*

7th July. State Electricity Commission of Western Australia, Perth. One 20 MVA three-phase transformer for East Perth power station. (E.S.B. 9351/55. Ten/13689.)*

Bentley-with-Arksey.—31st May. U.D.C. Street lighting equipment. (See this issue.)

Birmingham.—25th May. Public Works Committee. Electric street lighting equipment for one year from 1st July. City engineer and surveyor, Civic Centre.

Bushey.—6th June. U.D.C. Street lighting scheme. (See this issue.)

Carshalton.—20th May. U.D.C. Supply and erection of 133 lighting columns. (See this issue.)

Chile.—16th May. Shipping Department, Chilean State Railways, Valparaiso. Seven ships' radar sets with electrical generating equipment. (E.S.B. 9405/55. Ten/13655.)*

Cumberland.—Dalston Parish Council. Street lighting installation. Fifteen lamps, Class B, and concrete columns. Clerk, 22, Grasmere Street, Carlisle.

Denmark.—13th June. Forsvarets Telegrafforvaltning, Copenhagen. Equipment for signal installations for pipe-line systems, including underground and submarine cables, loading coils, waterproof telephones, teleprinters and "walkie-talkie" radio equipment. (E.S.B. 1071/55. Ten/13681.)*

Egypt.—27th June. Ministry of Public Works, Cairo. Two 5,000 kW and two 600 kW turbo-alternators, steam generating plant, switchgear, transformers, etc. (E.S.B. 9744/55. Ten/13709.)*

Formosa.—4th June. Central Trust of China, Taipei. 3,000 kVA, 3-phase unit substation. (E.S.B. 9326/55. Ten/13660.)*

Goole.—23rd May. Borough Council. Electrical work in 33 houses and two garages, Western Road and Charles drive. T. Waterfall, borough surveyor, Municipal Offices.

Hull.—10th June. Corporation. Private automatic branch telephone exchange. (See this issue.)

India.—6th June. Director of Industries and Central Purchasing Officer, Bombay. Indoor and outdoor 11 kV equipment for the power supply for construction works of the Koyna hydro-electric project. (E.S.B. 9369/55. Ten/13645.)*

16th June. Bombay Electric Supply and Transport Undertaking. Communication and control cables. (E.S.B. 9366/55. Ten/13673.)* Multicore control cables. (E.S.B. 9367/55. Ten/13674.)* 17th July. 22 kV and 6·6 kV switchgear and accessories. (E.S.B. 9365/55. Ten/13677.)*

20th May. Director General of Supplies and Disposals, New Delhi. Fifty turbine-type bore hole pumping sets. (E.S.B. 9835/55. Ten/13715.)* One 5,000 kW turbo-alternator and 35,000 lb/hr water tube boiler for Jaipur power station. (E.S.B. 9775/55. Ten/13695.)* 10th August. Two 3,000 kW turbo-alternator sets, two 45,000 lb/hr boilers, indoor and outdoor switchgear and cables for Jodhpur station. (E.S.B. 9492/55. Ten/13690.)* Two turbo-alternator sets, boilers and associated switchgear for Bharatpur station. (E.S.B. 9771/55. Ten/13691.)* Two turbo-alternator sets, boilers, switchgear, etc., for Bhilwara station. (E.S.B. 9772/55. Ten/13692.)* Two turbo-alternator sets, boilers, switchgear, etc., for Alwar power station. (E.S.B. 9774/55. Ten/13694.)* Two turbo-alternators, boilers, switchgear and cables for Kotah power station. (E.S.B. 9773/55. Ten/13693.)*

31st May. Government of Andhra Electricity Department, Madras. Two 7,500 kVA and six 5,000 kVA power transformers. (E.S.B. 9411/55. Ten/13648.)*

29th June. Damodar Valley Corporation. 11-132 kV, 55 MVA power transformer. (E.S.B. 8996/55. Ten/13601.)*

Iraq.—5th July. Directorate General of Municipalities, Baghdad. One 250 kW alternator set for the Shamiya power station. (E.S.B. 9485/55. Ten/13687.)* 9th July. Three 75 kW diesel alternator sets, etc. (E.S.B. 8853/55. Ten/13611.)* 19th July. Three 250 kW and one 90 kW alternators, and 500 kVA transformers. (E.S.B. 9482/55. Ten/13664.)*

Longbenton.—28th May. U.D.C. Sodium vapour street lighting units. (See this issue.)

Middlesbrough.—20th May. Borough Council. Electric lamps and unit dry cells for one year from 1st July. Borough engineer, Municipal Buildings.

New Zealand.—3rd June. Director-General (Stores Division), G.P.O., Wellington. 120,000 insulators. (E.S.B. 9511/55. Ten/13647.)* 9th June. 100 miles of polythene insulated and p.v.c. sheathed cable. (E.S.B. 9512/55. Ten/13657.)*

5th July. Wellington Corporation Transport Department. Thirty-three trolley-buses. (E.S.B. 7144/55. Ten/13598.)*

South Africa.—1st June. Stores Department, South African Railways. Private automatic exchanges and master sets. (E.S.B. 9242/55. Ten/13651.)* 2nd June. 10,000 suspension insulators. (E.S.B. 9384/55. Ten/13646.)*

Spain.—23rd May. Ministerio del Aire, Madrid. One 350 kV diesel generating set. (E.S.B. 9584/55. Ten/13669.)*

United States.—2nd June. Bureau of Reclamation, Denver, Colorado. Two generator-voltage switchgear assemblies, four 75 kVA transformers, and four 55 kW resistors for the Palisades power plant. (E.S.B. 9651/55. Ten/13671.)*

31st May. Corps of Engineers, Alabama. 44,000/58,667 kVA transformer. (E.S.B. 9618/55. Ten/13732.)*

Uruguay.—20th June. Ministerio de Salud Publica. X-ray apparatus and accessories. (E.S.B. 9493/55. Ten/13666.)*

21st June. Direccion General de Comunicaciones. Radio transmission valves. (E.S.B. 9494/55. Ten/13670.)*

West Riding.—23rd May. County Council. Re-wiring work at Thorne Grammar School. (See this issue.)

13th June. Maintenance of refrigerators in school kitchens. (See this issue.)

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).

ORDERS PLACED

Bournemouth.—Housing and Estates Committee. Installation of additional lighting points in pre-war houses (£2,010).—Southern Electricity Board.

Brigg.—U.D.C. Installation of 48 sodium and 10 fluorescent Class A street lighting units on concrete columns and a further seven fluorescent Class A units on wall brackets (£4,009).—G.E.C.

Chester.—Housing Committee. Recommended. Electrical installations in 150 houses at Blacon (£3,387.)—Engineering Service Installation (extension of contract).

Dorchester.—Corporation Highways Committee. Recommended. Improved lighting between Greys Bridge and Damers Barn (£4,894).—Revo Electric Co.

Enfield.—Education Committee. Recommended. Lighting installation at Chase Side School (£1,193).—Iverson Electrical.

Glasgow.—Corporation Cleansing Committee. Supply of 28 traction batteries (£15,219).—Tudor Accumulator Co.

Hendon.—Housing Committee. Electrical installation work in flats at Hendon Park Row, Golders Green (£1,542).—E. Wright & Co.

Newbury.—Corporation Housing Committee. Recommended. Electrical installations in 86 houses, St. George's Avenue estate (£2,000).—Home Electrics (Newbury).

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Acton.—Works extensions, Kendal Avenue; Metal Box Co., Ltd., The Langham, Portland Place, London W.1.

Aireborough.—Proposed Yeadon and Rawdon Secondary School; John Burnet Tait & Partners, architects, 10, Bedford Square, London, W.C.2.

Banstead.—Central library, Bolters Lane, and branch library on another site; J. Harrison, Surrey county architect, County Hall, Kingston-on-Thames.

Barnsley.—Secondary modern school at Kendray; James Miller & Partners, Ltd., Newmillerdam, Wakefield.

Berwick-on-Tweed.—Houses (200), Spital Hall estate, as first development; borough surveyor, Municipal Buildings.

Birkenshaw.—Secondary school; J. G. L. Poulson, architect, 29, Ropergate, Pontefract.

Bo'ness.—Houses (100); Scottish Special Housing Association, Ltd., 15/21, Palmerston Place, Edinburgh.

Brighton.—Home for old people on the Craven Vale estate (£38,000); borough surveyor, 26/30, King's Road.

Flats (14), Hollingbury, and houses (219), North Woodingdean estate, Wick Farm portion; borough engineer and surveyor.

Bristol.—Houses (71), Stillingfleet Road, Hartcliff, and flats (40), on site in Great George Street; city architect, Eagle House, Colston Avenue.

Cardigan.—Grammar modern school; county architect, County Hall, Aberayron.

Chesterfield.—Housing estate of between 250 and 300 houses adjoining Church Lane and Blacksmith Lane, Calow; Butterley Co., Ltd., Ripley.

Croydon.—Hostel in Wellesley Road for Y.M.C.A.; E. F. Starling, architect, 6, Queen Anne's Gate, London, S.W.1.

Doncaster.—College of further education, Beechfield Gardens; borough architect.

Edinburgh.—Six-storey block of flats, Inverleith; Wm. Arnott McLeod & Co., Ltd., builders, Russell Road West.

Fakenham.—Four-stream secondary modern school; Norfolk education architect, Stracey Road, Norwich.

Gateshead-on-Tyne.—Factory, Park Road, for Jackson the Tailor; Stephenson & Gillis, Saville Chambers, North Street, Newcastle.

Glasgow.—Factory for Victoria Biscuit Works; P. & W. Anderson, Ltd., 3, Woodside Terrace.

Works extensions; Fairfield Shipbuilding & Engineering Co., Ltd., 1048, Govan Road.

Great Billing.—Private estate of 46 houses, Billing Hall; Northampton Brewery Co., Ltd., Northampton.

Guildford.—Houses (30) at The Rough, West Horsley, for R.D.C.; J. W. Wilton, surveyor, Millmead House.

Halstead.—Area offices, Fenn Road; Essex Rivers Board, Rivers House, Springfield Road, Chelmsford.

Harrington. — Works extensions; Vale Carpet Co., Ltd., Vale Works.

Holbeach.—County secondary school; county architect, Boston.

Hull.—Four-storey showrooms and offices, Paragon Street; Leeds Permanent Building Society, The Headrow, Leeds.

Jarrow.—Additions to factory for Abbott Laboratories (England), Ltd., pharmaceutical manufacturers; Spence & Price, architects, 26, St. Mary's Place, Newcastle-on-Tyne.

Cinema, Leam Lane, for Dawe Bros.; Stephenson & Gillis, Saville Chambers, North Street, Newcastle-on-Tyne.

Kettering.—Primary school, Grange estate; county architect, Northampton.

Loughborough.—Factory extensions; W. Hammond & Son (Bearded Needles), Ltd., Havelock Street.

Lowestoft.—College of further education in St. Peter's Street; East Suffolk county architect, County Hall, Ipswich.

Machynlleth.—Houses (30), Tanrallt site, for U.D.C.; Walter B. Bond, surveyor to Council, Windsor House, 49, Calthorpe Road, Edgbaston, Birmingham, 15.

Mansfield. — Houses (42), Ladybrook estate, Site 5E; borough surveyor, Carr Bank.

Murton Colliery (Co. Durham).—Houses (68); R. R. Lumsden, surveyor, R.D.C. Offices, Easington.

Newcastle-on-Tyne.—Offices and laboratories at works of Thomas Hedley & Co., soap manufacturers, City Road, and additional offices for British Engines, Ltd., Glasshouse Street; Dryden & Shaw, Market Street.

Factory and offices at Fawdon for Scott & Turner, Ltd. (£1,000,000); Cackett, Burns Dick & McKellar, 21, Ellison Place.

Four-storey block of warehouses and offices; C.W.S. architect's department, 90, Westmoreland Road.

Houses (44), Silver Lonnen; R. Bowey & Son, Great North Road.

Newton Abbot.—Factory; Centrax Power Units, Ltd., 83, High Street, Brentford.

Northampton.—Houses (65), shops, bungalows and village hall, Billing; R.D.C. architect.

Northants.—Conversion of Franklins Hotel, Guildhall Road, into County Council offices; county architect, Northampton.

North Shields.—Residential flats in Wallsend Road West; G. H. Gray & Partners, Camden Street.

Norwich.—Reconstruction and extension of Castle Hotel; H. C. Greengrass & Sons, Ltd., builders, 56, Pitt Street.

Oakham (Rutland).—Houses at Exton (12), and Cottesmore (20); R.D.C. architect.

Oldbury.—Maisonnettes (24), Stone Street; Wood, Kendrick & Williams, architects, 57, Colmore Row, Birmingham.

Oxford.—Extensions to buildings, Somerville College; T. H. Kingerlee & Sons, Ltd., builders, 35, Queen Street.

Penrith.—Clothing factory at Gilwilly site for Redmayne & Sons; Barwick Bros., Carlisle.

Plymouth.—Houses, etc. (647), Southway West, and 72 flats on Lipstone site; J. Paton Watson, borough surveyor, Guildhall.

Pontefract.—Carleton Primary School; James Cubitt & Partners, architects, 25, Gloucester Place, London, W.1.

Port Talbot.—Extensions to Abbey Works for Steel Company of Wales, Ltd.; W. S. Atkins & Partners, architects, 158, Victoria Street, London, S.W.1.

Preston.—Pathological laboratories at Royal Infirmary for Regional Hospital Board; Lillie & Kirkham, architects, Winckley Square.

Redditch.—Extensions to county high school (£144,000); J. Harper & Son, Ltd., Blackheath.

Rochdale.—Research buildings for Courtaulds, Ltd.; J. Gerrard & Sons, Ltd., Swinton, near Manchester.

Pathological laboratory at Birch Hill Hospital; Manchester Regional Hospital Board, Cheetwood Road, Manchester, 8.

Shopping centre, Kirkholt estate (£94,250); W. H. Mercer, borough surveyor, Town Hall.

Rotherham. — Shopping centres at East Herringthorpe and Kimberworth Park estate; E. J. Manson, borough surveyor, Municipal Offices.

Rothwell.—Houses (30), Wood Lane site, for U.D.C.; Harlow & Milner, Ltd., Warren Yard, Warrengate, Wakefield.

Scunthorpe.—Extensions to offices for Appleby Frodingham Steel Co., Ltd.; Quibell & Hardy, Ltd., 17, Henry Street.

Shops, offices, market hall, etc., High Street, Ashby; borough architect.

Seisdon.—General hospital; Birmingham Regional Hospital Board, 10, Augustus Road, Birmingham, 15.

Shrewsbury.—Houses (70), Judith Butts Gardens, and 56 at Crowmoor; borough surveyor, Guildhall.

Sidcup.—St. Mary's Boys' Grammar School (£116,000); C. H. Gibson, Ltd., builders, 509, London Road, Thornton Heath.

Southampton.—Works and offices for Calor Gas Distributors, Ltd.; Foster Wheeler, Ltd., contractors, Ixworth Place, London, S.W.3.

South Shields.—Houses (224); borough engineer.

Stafford.—Rebuilding of premises at Martin Street for J. Mottram, Ltd.; A. Hall & Son, 73, Peel Terrace.

Stamford.—Additional storey at nurses' home, Stamford and Rutland Hospital; East Anglian Regional Hospital Board; 33, Parkside, Cambridge.

Thorne (Yorks).—Houses (30), South Common estate; R.D.C. architect.

Towcester.—Houses (50), Burcote Road estate; R.D.C. architect, Towcester, Northants.

Wakefield.—Works extensions; British Jeffrey-Diamond, Ltd., Thornes Works.

Flats (52), Portobello estate; city engineer, Town Hall.

Warrington.—Secondary school, Long Lane; G. & J. Seddon, Ltd., Little Hulton, near Bolton.

Watford.—Houses (28), Cecil Lodge site, Abbots Langley, for R.D.C.; Dawe, Carter & Partners, architects to Council, 33, Clarendon Road.

West Bromwich.—Works and offices; A. J. Crump & Sons, Ltd., Aston Road, Dudley.

Whitley Bay (Northumberland).—Block of flats, Monkseaton; E. Roberts, borough surveyor, Council Offices.

Wimbledon.—Extensions to Atkinson Morley Hospital, Copse Hill; Adams, Holden & Pearson, architects, 38, Gordon Square, London, W.C.1.

Worcestershire. — Secondary modern school, Wythall (£105,316); A. H. Guest, Ltd., Stourbridge.

Wrexham.—Conversion of Wrens Nest to form old people's home (£20,800); Denbighshire county architect, Grove Park, Wrexham.

NEXT WEEK'S EVENTS

Organizers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged

Sunday, 15th May, to Wednesday, 18th May

WORTHING.—E.T.U. Conference.

Monday, 16th May

IPSWICH.—Electric House, 7.30 p.m. Ipswich & District Electrical Association. Annual general meeting.

LONDON.—Savoy Place, 6.30 p.m. I.E.E. London Students' Section. Annual general meeting, followed by an address by the President.

Tuesday, 17th May

LONDON.—Savoy Place, 6 p.m. I.E.E. Education Discussion Circle. Questions night.

Connaught Rooms, W.C.2, 12.30 for 1 p.m. Electrical Industries Club. Luncheon.

Tuesday, 17th May, to Saturday, 21st May

TORQUAY.—Institute of Metal Finishing. Annual Conference.

Wednesday, 18th May

LONDON.—Savoy Place, 5.30 p.m. I.E.E. Supply Section. "The Supply of Electricity in the London Area," by D. B. Irving.

I.E.E. London Students' Section. Visit to Safety, Health and Welfare Museum, Horseferry Road, at 2 p.m.

London School of Hygiene & Tropical Medicine, Keppel Street, 6.30 p.m. British Institution of Radio Engineers, London Section. "The Development of the Underwater Television Camera," by D. R. Coleman, D. A. Allanson and B. A. Horlock.

MANCHESTER. — Engineers' Club, Albert Square, 7 p.m. A.S.E.E. Manchester Branch. Annual general meeting.

SOUTHAMPTON.—Polygon Hotel, 8.15 p.m. A.S.E.E. Southampton Branch. "Employer's Liability," by R. Hughes.

WIMBLEDON. — The Guild House, 32, Worple Road, 7.15 p.m. A.S.E.E. South-West London Branch. Film night.

Wednesday, 18th May, to Friday, 20th May

ST. ANNES-ON-SEA.—Hotel Majestic. Incorporated Plant Engineers. Annual conference.

Thursday, 19th May

DUBLIN.—59, Merrion Square, 6 p.m. I.E.E. Irish Branch. Annual general meeting.

LONDON.—Savoy Place, 5.30 p.m. Institution of Electrical Engineers. Annual general meeting, followed at 6.30 p.m. by "Human Relations in Industry," by Lord Citrine.

John Adam Street, W.C.2, 5.15 p.m. Royal Society of Arts. Thomas Holland Memorial Lecture, "Scientific Research in India," by Prof. Sir Alfred Egerton.

WATFORD.—Clarendon Hotel, Station Road, 8 p.m. A.S.E.E. Watford Branch. "Industrial Psychology," by A. Angles.

Friday, 20th May, to Sunday, 22nd May

SCARBOROUGH.—Spa Theatre. National Industrial Safety Conference and exhibition of industrial safety appliances.

Friday, 20th May, to Monday, 23rd May

ST. AUSTELL.—Carlyon Bay Hotel. I.E.E. Western Centre. Summer meeting.

Saturday, 21st May

HARWELL. — I.E.E. Utilization Section. Visit to the Atomic Energy Research Establishment.

LONDON.—I.E.E. London Students' Section. Visit to P. & O. liner, Tilbury.

PRESTON. — I.E.E. North-Western Supply Group summer outing. Visit to English Electric Co. works, followed by coach trip.

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